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NATURAL HISTORY
OF THE
ANIMAL KINGDOM,
FOR
THE USE OF YOUNG PEOPLE.

IN THREE PARTS,

COMPRISING:

I.—MAMMALIA. II.—BIRDS.

III.—REPTILES, AMPHIBIA, FISHES, INSECTS,
WORMS, MOLLUSCS, ZOOPHYTES, &c.,

WITH 91 COLOURED PLATES, INCLUDING ABOUT 850 FIGURES,
AND NUMEROUS ADDITIONAL ILLUSTRATIONS IN THE TEXT.

ADAPTED FROM THE GERMAN OF PROFESSOR VON SCHUBERT

BY

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AUTHOR OF "EUROPEAN BUTTERFLIES AND MOTHS," &c.

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Systematic Arrangement

of the

Classes and Orders of the Animal Kingdom

as adopted in the present work.

M a n.

Subkingdom I. Vertebrata.

a) With warm red blood.

Class I. **Mammalia.**

- Order 1. *Primates* (Apes and Lemurs).
2. *Dermoptera* (Flying Lemurs).
3. *Chiroptera* (Bats).
4. *Insectivora* (Insect-Eaters).
5. *Carnivora* (Flesh-Eaters).
6. *Pinnepedia* (Seals).
7. *Rodentia* (Gnawing Animals).
8. *Proboscidea* (Elephants).
9. *Perissodactyla* (Rhinoceros, Horse &c.).
10. *Artiodactyla* (Pigs and Hippopotamus).
11. *Ruminantia* (Ruminating Animals).
12. *Sirenia* (Manatees and Dugongs).
13. *Cetacea* (Whales and Dolphins).
14. *Edentata* (Toothless Animals).
15. *Marsupialia* (Pouched Animals).
16. *Monotremata* (Duck-Bill & Spiny Anteater).

Class II. **Aves.**

a) **Insessores.**

- Order 1. *Accipitres* (Birds of Prey).
2. *Scansores* (Climbing Birds).
3. *Syndactyla* (Hornbills and Kingfishers).
4. *Passeres* (Singing Birds).
5. *Columbæ* (Pigeons).

b) **Autophagi.**

- Order 6. *Gallinæ* (Poultry and Game Birds).
7. *Cursoræ* (Running Birds).
8. *Grallatores* (Wading Birds).
9. *Palmipedes* (Swimming Birds).

b) With cold red blood.

Class III. **Reptilia.**

- Order 1. *Ophidia* (Snakes).
2. *Crocodylia* (Crocodiles).
3. *Lacertilia* (Lizards).
4. *Chelonia* (Tortoises).

Class IV. **Amphibia.**

- Order 1. *Anoura* (Frogs and Toads).
2. *Urodela* (Newts).
3. *Ichthyoidea* (Sirens).
4. *Apoda*.

Class V. **Pisces.**

Subclass I. **Dipnoi.**

Subclass II. **Teleostei.**

- Order 1. *Acanthopterygii*.
2. *Pharyngognathi*.
3. *Anacanthini*.
4. *Physostomi*.
5. *Plectognathi*.
6. *Lophobranchii*.

Subclass III. **Chondropterygii.**

- Order 1. *Ganoidei*.
2. *Selachii*.
3. *Cyclostomi*.
4. *Leptocardii*.

Subkingdom II. Articulata.

Class I. **Insecta.**

a) With perfect metamorphoses.

- Order 1. *Coleoptera* (Beetles).
2. *Hymenoptera* (Bees and Wasps).
3. *Lepidoptera* (Butterflies and Moths).
4. *Diptera* (Flies).
5. *Neuroptera* (Dragonflies &c.).

b) With imperfect metamorphoses.

- Order 6. *Orthoptera* (Crickets &c.).
7. *Hemiptera* (Bugs).

Class II. **Arachnida.**

- Order 1. *Arthrogastra* (Scorpions).
2. *Araneida* (Spiders).
3. *Acarina* (Mites).

Class III. **Myriopoda.**

- Order 1. *Chilopoda* (Centipedes).
2. *Chilognatha* (Millepedes).

Class IV. **Crustacea.**

Section I. **Malacostraca.**

- Order 1. *Thoracostraca* (Crabs).

- Order 2. *Arthostraca* (Wood-lice &c.).

Section II. **Entomostraca.**

- Order 1. *Branchiopoda.*
2. *Ostracoda.*
3. *Copepoda.*
4. *Cirripedia* (Barnacles).

Subkingdom III. Mollusca.

Group I. Tunicata.

Class I. **Thaliacea.**

Class II. **Ascidiaë.**

Group II. Mollusca (typical).

Class I. **Cephalopoda** (Cuttle-Fishes).

II. **Heteropoda.**

III. **Pteropoda.**

Class IV. **Gastropoda** (Snails &c.).

- Order 1. *Branchiata.*
2. *Pulmonata.*

Class V. **Lamellibranchiata** (Bivalves).

Group III. Molluscoidea.

Class I. **Brachiopoda.**

Class II. **Bryozoa.**

Subkingdom IV. Vermes.

Class I. **Rotatoria** (Wheel Animalcules).

II. **Annelida.**

- Order 1. *Chaetopoda* (Worms).
2. *Hirudinei* (Leeshes).

Class III. **Gephyrea.**

Class IV. **Nemathelminthia.**

- Order 1. *Nematoda* (Thread-Worms).
2. *Acantocephali.*

Class V. **Plathelminthia.**

- Order 1. *Turbellaria.*
2. *Tremadota.*
3. *Cestoda* (Tape-worms).

Subkingdom V. Echinodermata.

- Order 1. *Echinoidea* (Sea-Urchins).
2. *Asteroidea* (Starfishes).

- Order 3. *Crinoidea.*
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Subkingdom VI. Coelenterata.

Class I. **Ctenophora.**

II. **Polypomedusæ.**

- Order 1. *Acalepha* (Jelly-fishes).
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<i>Trigla Gurnardus</i>	III	12	XIV k	<i>Ungulata</i>		117		<i>Zeuzera æsculi</i>	III	26	XXVI b
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<i>Triphæna Pronuba</i>	III	28	XXVI s	pictorum	III	53	XXI k	<i>Zoea</i>	III	46	
<i>Tristomum coccineum</i>	III	57	XXVIII v	<i>Upupa epops</i>	II	7	VIII f	<i>Zygæna malleus</i>	III	16	IX b
<i>Triton cristatus</i>	III	8	VI b	<i>Upupidæ</i>	II	7					
<i>Tritonidæ</i>	III	8		<i>Uranoscopus scaber</i>	III	11	XIII a				
<i>Tritonium nodiferum</i>	III	52	XXI e								

INTRODUCTION.



THE MAMMALIA stand at the head of the whole Animal Kingdom. They form the first Class in the highest group of animals, the Subkingdom **VERTEBRATA**.

The body of all vertebrate animals is symmetrical, or similarly formed on both sides. The many-

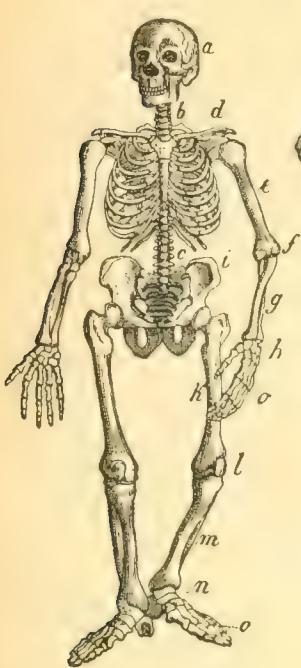
most important organs of sense are in the head. In the veins flows red blood.

The subkingdom Vertebrata is divided into five principal classes; Mammals, Birds, Reptiles, Amphibia, and Fishes. The general characters of the Mammalia may be briefly summed up as follows:

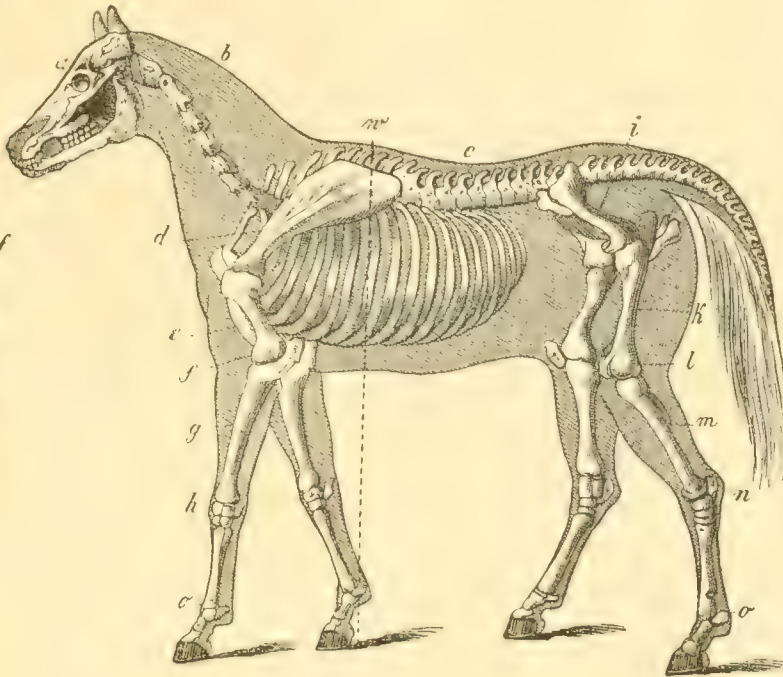
The Mammalia are vertebrate animals with warm red blood, and their skin is generally clothed with hair. They bring forth living young, which they suckle.

We can easily acquaint ourselves with the general structure of the Vertebrata by examining our own bodies. In fact, naturalists include man in the system of nature, and place him at the head of the animal kingdom. All the organs which man possesses are found in other mam-

mals under more or less varying forms. We may convince ourselves of this fact if we compare their



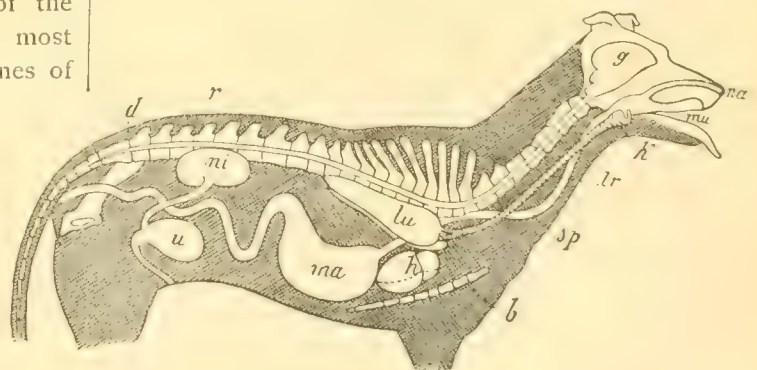
Skeleton of Man.



Skeleton of Horse, with outline.

a. Head. b. c. Vertebral Column. d. Shoulder. e. Upper Arm. f. Elbow joint. g. Fore Arm. h. Wrist. i. Pelvis. k. Thigh. l. Knee-joint. m. Leg. n. Ankle. o. Fingers or Toes. w. Withers (of Horse).

jointed skeleton forms a bony framework for the attachment of the soft muscles, which are covered by a continuous skin. The main divisions of the body consist of the head, the trunk, and, in most cases, of two pairs of limbs. Part of the bones of the head compose the skull, which forms a hollow case containing the brain, which is the main source of perception and motion. At the back, the brain is connected with the spinal marrow, which lies in a continuous cavity in the centre of the vertebræ, or bones which form the spine. Beneath the spine (or rather, before it in man) and partly enclosed by the ribs, we find the lungs, or organs of respiration (breathing); the heart, the central organ which regulates the circulation of the blood; the liver, the pancreas, the stomach, the intestines and other organs connected with the digestion and assimilation of food. The



Internal Anatomy of Dog.

b. Breastbone. d. Gut. g. Brain. h. Heart. k. Larynx. lr. Trachea. lu. Lungs. ma. Stomach. mu. Mouth. na. Nostrils. ni. Kidney. r. Spinal Cord. sp. Gullet. u. Bladder.

skeletons. The other organs of man and animals correspond in a similar manner. The organs of sense

occupy the same positions, and have the same functions. This is also the case with the internal organs, the positions of which may be seen in the accompanying figure.

The habits of Mammalia show that they possess a certain amount of intelligence, which may be artificially stimulated by man, but which also increases with the age and experience of animals. Many possess constructive faculties, which they employ in making nests or burrows for themselves. Some animals have a strong tendency towards migration, which is probably increased by scarcity of food. Other species hibernate, or sleep through the winter, during which time they take no food, their breathing becomes very slow, and the temperature of the blood sinks nearly to freezing-point.

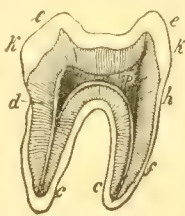
There are no venomous species among mammals, but some are dangerous to man from their size and strength, while others are destructive to useful crops, as well as to the products of human industry. But many kinds are useful to man either alive or dead, and others are preserved as domestic animals.

There are about 3000 species of Mammalia existing on the earth at present. Besides these, the petrified remains of many other species have been discovered, which throw great light on the former history of our earth, and on the present distribution and condition of the animal world.

The organs of animals are all adapted to their manner of life. This is especially the case with the teeth, and with the organs of motion, which are consequently of the greatest importance in the classification of Mammalia.

The Teeth of Mammalia.

The jaws of Mammalia usually contain a series of teeth in separate sockets. A perfectly developed tooth is divided into the crown, which is the exposed portion; the neck, or the part covered by the gum; and the roots or fangs, which are fixed in the jaw. The hard portion of the tooth is composed of a substance called dentine, or ivory, and this encloses a hollow called the pulp-cavity, which is filled up with nerves and blood-vessels. The crown is encompassed by a hard substance called enamel, and the fangs are surrounded by a bony crust, known as the cement.



Section of Molar Tooth in Man
c. Cement d. Dentine. e. Enamel f. Fang, k. Crown. h. Neck. p. Pulp-cavity.

According to their shape and position, teeth are divided into incisors (cutting-teeth, or front-teeth), canines (dog-teeth, or eye-teeth), and molars (back-teeth, double teeth, or grinding-teeth).

The latter are of very different forms, according to the food of the animal, and we shall frequently have occasion to refer to them.

The teeth are not always fully developed, according to the description which we have given. Thus

the enamel may be absent (as in the Sloths) or it may be absent on one side (as in the incisors of the Rodentia). Sometimes, too, the fangs are absent, and in this case, the tooth continues to grow during the whole life of the animal (as in the incisors of the Elephant, and of the Rodentia). On the other hand, the enamel may penetrate into the dentine, and form several layers, which become visible on the upper



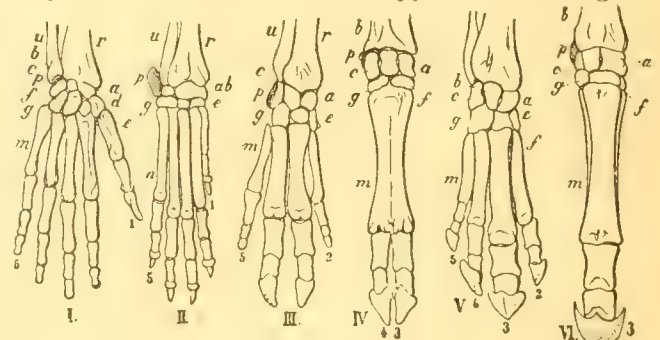
Teeth of the left upper jaw in man.
s Incisors. e. Canine Tooth.
b Molars (2 small and 3 large).
Rodentia, horses and Ruminating animals). When these folds completely cover the divisions of the dentine, we have a compound tooth (Elephant; molars).

The number of teeth is indicated by a special formula. In man this is $\frac{5-1-4-1-5}{2-1-5}$ or more briefly, $\frac{2-1-5}{2-1-5}$. This means that man possesses on each side of each jaw 2 incisors, 1 canine and 5 molars. The first set of teeth, which fall out soon after birth, are called milk-teeth. They are only lost a short time, and are then replaced by permanent teeth. The hinder molars are not found in the set of milk-teeth, and therefore are never changed, when once developed. The full formula of the milk-teeth in man is as follows: $\frac{2-1-4-1-2}{2-1-4-1-2}$.

Structure of the Feet in Mammalia.

If we examine the hands and feet in the skeleton of a man, we shall find that they are composed of a considerable number of bones. There are eight small bones of about equal size in the wrist, which are arranged in two rows. The ankle is composed of seven bones, which differ much in size, and the largest projects in such a manner as to form the heel.

The middle of the hand and foot each contain five bones. These are jointed to the five fingers and toes, each of which is composed of three joints, except the thumb and the great toe, which have only two. The thumb can be opposed to the fingers,



Bones of arm or fore feet of various Mammalia.
r. Radius. u. Ulna a. b. c. d. e. f. g. h. Bones of Wrist
1-5 Digits. I. Man. II. Dog. III. Pig. IV. Ox V. Tapir. VI. Horse.
and some animals have the power of placing the great toe in a similar position, though the foot is not thereby converted into a perfect hand. The great toe is partially opposable among certain races of savages, who sometimes row with their feet; and

instances have occasionally occurred among white races, of armless men writing and drawing with their toes. When the great toes are opposite in animals, the feet are termed grasping feet (or more usually hands), as in the case of those of apes.

But the extremities of the limbs of Mammalia are not always provided with five moveable toes. There may be 4, 3, 2 and even only one toe present, the others being absent or rudimentary. Some of these cases are illustrated in the accompanying figures.

The bones of the hands and feet are differently formed in different groups of mammals, and are used for various purposes, such as running, leaping, climbing, digging, flying, swimming, seizing prey, &c.

The last joints are rarely provided with flat nails, as in man. They are more frequently furnished with claws (as in beasts of prey), or with a shoe-like hoof covering the last joints. Sometimes the last joints are unarmed. The feet are also classified according to the manner in which animals walk. Either the entire surface of the foot touches the ground, as in the bear, or only the toes touch the ground, as in the cats, while in the horse only the last joint touches it.

Man is frequently regarded as forming the first Order of Mammalia. But it will be more convenient for us to treat man as forming a separate section in the present work.

MAN.

(Frontispiece.)

Man occupies the highest position in nature. His reason and power of speech place him far above all animals. It is true that some animals are superior to him in physical strength, size, and activity, and in the keenness of their senses, or in some other particulars, but no animal is so symmetrically formed, or possesses such a wonderfully constructed hand; no animal is fitted to develop its powers in so many different directions, and no animal walks upright, like man.

We may enumerate many points in which the structure of man differs from that of the other Mammalia. The skull, and the brain which it contains form the largest part of the head, the jaws project very slightly, if at all, though the nose and chin are distinctly prominent; the forehead is high, and like the greater part of the body, is free from hair, while the upright position and the strong legs allow the hands and arms full liberty of motion. The position of the body corresponds with the form of the verte-

bræ. The teeth stand close together in a row of equal height, and are not separated by any gaps. The human body can adapt itself to the most different climates of the earth, although some races of men are better fitted to endure extremes of heat or cold than others.

The human race is scattered over the earth to the number of perhaps nearly 1,400,000,000; and we meet with such considerable differences among the inhabitants of different countries, that we are obliged to recognise the existence of several species of man, or as we usually prefer to say, of several distinct races.

The older naturalists classified the races of men chiefly by their colour. Thus Blumenbach divided men into five races: Caucasians, Mongolians, Ethiopians, Americans and Malays. Cuvier joined the last two with the Mongolians, and reduced the number to three: White Races, Coloured Races and Black Races. Müller, taking language partly into consideration, admitted twelve races:

I. Straight-haired Races.

a) Soft-haired Races (Europe, North-Africa, Western Asia).

1. Mediterranean Race.
2. Nubian Race.
3. Dravidian Race (Ceylon and Further India).

b) Stiff-haired Races.

4. Malay Race.
5. Mongolian Race.
6. American Race.
7. Arctic Race (Esquimaux).
8. Australian Race.

II. Woolly-haired Races.

c) Fleecy-haired Races.

9. Negroes.
10. Kaffirs.

d) Bushy-haired Races.

11. Hottentots.
12. Papuans.

Types of these twelve races are shown in our Frontispiece.

Recent writers have recognised the extreme difficulty of separating mankind into distinct and well-defined races, and usually prefer to treat of the inhabitants of different parts of the world, or belonging to well-defined races, separately, rather than to attempt a hard-and-fast classification.

The shape of the skull differs much in different races and individuals. When the skull is long in proportion to its breadth, it is termed dolichocephalic, or long-headed; and when it is short and broad, it is called brachycephalic, or short-headed.

In many of the black races, the jaws project more, and the forehead recedes more than in ordinary Europeans, showing a lower grade of development.

We shall here restrict ourselves to some general remarks on the characteristics of the various races, according to colour.

The White Races (fig. 1) are of a pale flesh-colour, usually termed white, with blonde or dark hair, often curly, a large beard, an oval face, a high

forehead, and a more or less rounded skull. They are now met with in every country, and the greater part of the world is subject to their power. They, however, principally inhabit Europe, North-Africa, Arabia and South-Western Asia, as far as India.

The Coloured Races include the Mongolians, Malays, Esquimaux, and native Americans. They differ much in colour, some being almost as light as Europeans, others reddish (as the Americans) and others very dark (as the Malays). The most typical Mongolians, the Chinese and Japanese, have a yellowish skin, oblique eyes, high cheek-bones, straight black hair, and a scanty beard. The Coloured Races inhabit the whole of Asia, except the south-west; the Malay Islands, the Arctic Regions and America. They are also met with, more or less mixed, in many parts of Northern and Eastern Europe. Several types are represented in our figures 4—7.

The Black and Brown Races inhabit Africa, Australia, New Guinea, Polynesia, and some portions of Southern Asia. They differ very much in the form of their features, in the character of their hair, and in the amount of beard. The most typical African Negroes have thick lips, woolly hair, and little or no beard; but in many parts of Africa these characters

are more or less modified. This is doubtless due, at least in part, to admixture with distinct races, as for instance, with Arabs. Again, some black races of Southern Africa, the Hottentots, Bushmen, Kaffirs, &c., differ much from the negroes of tropical, and especially Western Africa.

The Australians have well-developed beards, while the hair of the Papuans forms a great mop.

Illustrations of several of the principal brown and black races are given in our figures 2, 3, 8—12.

The great difficulty in arriving at any satisfactory classification of the races of men, arises from their having become so greatly mixed. Our histories tell us much of the immigrations, conquests and blendings of various races within the last few centuries; but these records are but the latest of a long series of similar events. And unless man dwelt isolated, a race would with difficulty be kept pure; for it is demonstrable by the simplest arithmetical calculation, and making every allowance for intermarriages, that every person now living must have had a great number of ancestors living at one time, but a very few generations back, all of whom would not be likely to belong to the same unmixed race.

Class MAMMALIA.

The Class Mammalia is divided into a number of groups, called Orders, which are again divided into smaller sections, called Families.

Animals cannot, however, be arranged in a regular series which expresses all their affinities, nor are naturalists agreed on the relative importance of all the characters by which they are classified. All our systems, therefore, must be more or less artificial, though many groups, large and small, are perfectly natural and circumscribed within themselves.

The arrangement of Orders which we have adopted in the present work, is as follows:

- Order I. *Primates* (Apes, Monkeys, and Lemurs).
- II. *Dermoptera* (Flying Lemurs).

- III. *Chiroptera* (Bats).
- IV. *Insectivora* (Insect-Eaters).
- V. *Carnivora* (Flesh-Eaters).
- VI. *Pinnepedia* (Seals).
- VII. *Rodentia* (Gnawing Animals).
- VIII. *Proboscidea* (Elephants).
- IX. *Perissodactyla* (Rhinoceros, Horse, &c.).
- X. *Artiodactyla* (Pigs and Hippopotamus).
- XI. *Ruminantia* (Ruminating Animals).
- XII. *Sirenia* (Manatees and Dugongs).
- XIII. *Cetacea* (Whales and Dolphins).
- XIV. *Edentata* (Toothless Animals).
- XV. *Marsupialia* (Pouched Animals).
- XVI. *Monotremata* (*Ornithorhynchus* and *Echidna*).

Order I. Primates.

The apes have either four hands, or feet on their front legs and hands on their hind legs. They have a full set of teeth, as in man, but not close together, their eyes are parallel, and near together, and the teats are situated on the breast. They can raise themselves upright on their hind legs, like man, and

walk, though clumsily, but they far surpass man and most other mammals in springing and climbing. They live chiefly on fruits, but will also eat maggots, eggs, and small birds.

Apes are frequently called *Quadrumanæ*, or Four-handed Animals, from the structure of their limbs.

Sub-order I. Anthropoidea (Apes and Monkeys).

Section I. Catarrhini.

This section includes the apes and monkeys of the Old World, which resemble man in having the nostrils near together, whereas in all the American monkeys, the nostrils are wide apart.

A few species placed at the head of this division, such as the Gorilla, Chimpanzee, Orang-utan and Gibbons, are often called Anthropoid Apes, from their general resemblance to man.

Family Simiidae.

(Plate I.)

The *Simiidae* are unprovided with the tail and the cheek-pouches which are found in most other apes and monkeys. Their head is round, and though their eyes and ears are small, they are formed in the same manner as those of man, and the face and breast are bare. Their size resembles that of a fairly well grown man.

The largest and strongest of the Anthropoid Apes is the Gorilla (*Troglodytes gorilla*). Although Hanno, the Carthaginian navigator, brought skins to Carthage more than 2,000 years ago, which may have belonged either to the Gorilla or to the Chimpanzee, the Gorilla was quite unknown to modern naturalists until 1847, when it was discovered on the west coast of tropical Africa. If the Gorilla stood upright, he would measure nearly six feet in height. He has a long skull, and small ears; and his arms are so long that they reach below the knees. He generally goes on all fours, or climbs trees, though his short fingers are not so well adapted to this purpose as those of some other apes. Although the strength and ferocity of the Gorilla may have been somewhat exaggerated in the earlier accounts, yet he is nevertheless a most formidable animal, who fears neither man nor the large beasts of prey. When young, he lives in company, but when old in solitude, and is said to construct a kind of nest in trees. His food consists chiefly of roots, fruits, and the leaves of trees.

The Chimpanzee (*Troglodytes niger*) is represented on Plate I. fig. a. He is noted for his sociable disposition, and for the great quickness which he exhibits in learning to imitate various human actions. He grows to the height of rather less than four feet. His body is covered with long black hair except on the face and the palms and backs of the hands; the lower part of the body is also somewhat bare. The Chimpanzee lives in companies in the great forests of Upper and Lower Guinea, where he is both more widely distributed, and much commoner than the Gorilla. He feeds on roots and fruits. He passes the day on the ground, but at night retires to a nest which he forms in the trees at the height of twenty or thirty feet from the ground, and which is constructed of interlaced branches.

The Orang-utan (*Simia Satyrus*) or Wild Man of the Woods, is represented on plate I fig. b. He inhabits the marshy forests of the islands of Borneo and Sumatra, and lives in the trees. He is about as large as a Chimpanzee, but may easily be distinguished by his reddish colour, the much longer arms, which reach to the ankles, the more raised head, and the much more prominent muzzle.

The Gibbons are distinguished from all the other apes, except the Orang-utan, by their very long arms, which reach to the ankles when they stand. Only a few species are known, which inhabit the East Indies. Their man-like faces, and small callosities show their affinity to the Orang-utan and Chimpanzee; but they are considerably smaller and weaker. The long fore limbs and strong hind limbs are preeminently adapted for climbing. The chest is broad and prominent.

The White-handed Gibbon (*Hylobates Lar*) is represented on Plate I fig. c. It is a native of the Malay Peninsula, and is one of the most active of the whole family, and can easily pass over a space of thirty or forty feet in leaping from one tree to another. It is very variable in colour.

The Siamang (*Hylobates syndactylus*), represented

on Plate I. fig. 4 is the largest and stoutest of the genus, but is nearly as active as the other species. It inhabits the forests of Sumatra in large companies, leaping from tree to tree, and making the woods resound with its cries at sunrise and sunset.

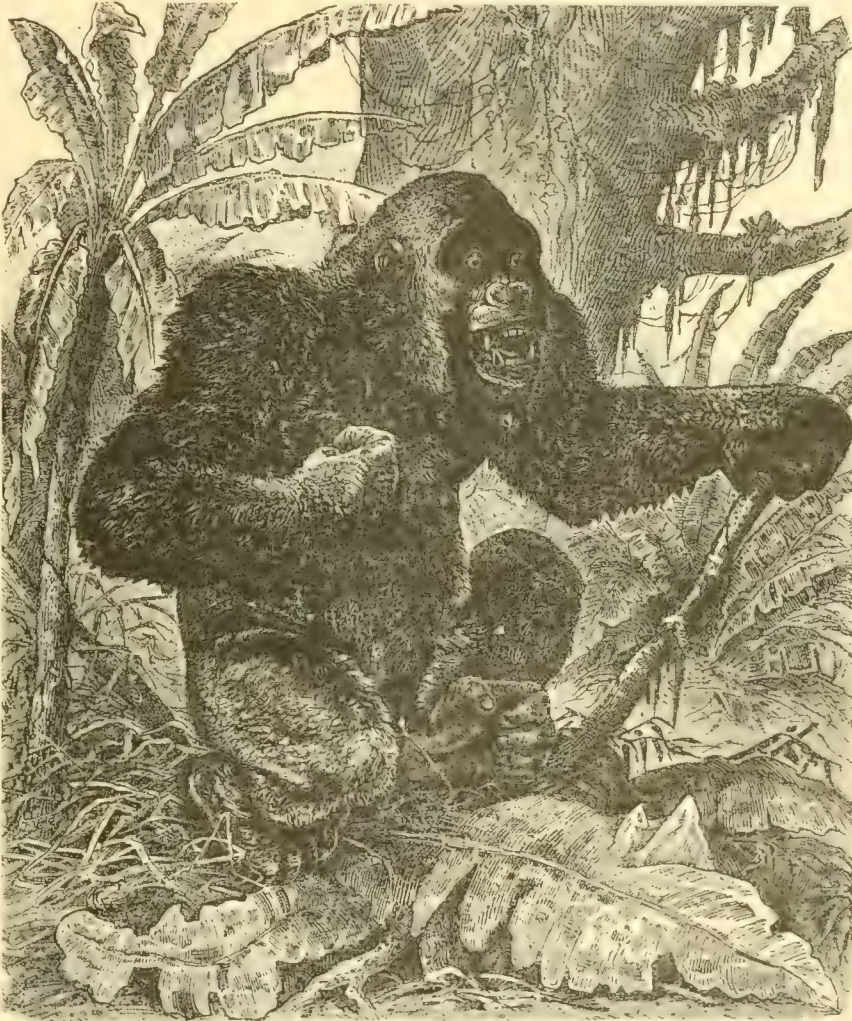
Family **Cercopithecidae.** (Plate II.)

The monkeys belonging to this and the following families are no longer dignified with the title of Anthropoid Apes. The *Cercopithecidae* have a slender form, long limbs, a long tail, a short snout, small callosities, and no cheek-pouches. They live in troops in the forests of Southern Asia, and feed on leaves and fruits.

One of the most beautiful species is the Hanumán Monkey (*Semnopithecus cutellus*), which is held sacred by the Indians. The original Hanumán is said to have been one of the principal heroes in the army of the demigod Rama, when he invaded Ceylon at the head of an army of bears and monkeys, to make war upon the giant Ravana, who had carried off Sita, the beautiful wife of Rama.

The Hanumán Monkey is exceedingly intelligent and sociable when young, but as it grows older, it loses many of its good qualities. Its jaws project, its forehead flattens, and it becomes heavy and stupid. Similar changes take place, with increasing age, in many other monkeys. (Figured on p. 6.)

The species of *Cercopithecus* somewhat resemble cats in their outward appearance. Their long tail, large



Gorilla

cheek-pouches, and large callosities show that they are far inferior in structure to the apes represented on Plate I. But they are not inferior to them in intelligence, and their activity and cleverness in many respects



Hanuman Monkey.

are truly surprising. They inhabit Africa, where they live in large troops under the leadership of an old male. They wander through the woods and fields, and commit great depredations in the plantations of the natives.

One of the species most frequently seen in Europe is the Green Monkey (*Cercopithecus sabaeus*) figured on Plate II. fig. b. It has often been known to breed in captivity, when well taken care of. It is a native of Western Africa.

The species of the genus *Macacus* and its allies form a small group inhabiting Southern Asia and Africa. The snout is much more prominent than in *Cercopithecus*, and the tail is long in some species, and short, or even almost wanting in others. The

only Quadrumanous animal which now inhabits Europe in a wild state, is the Barbary Ape (*Inuus caudatus*) figured on Plate II. fig. f. A colony of this animal (whether originally introduced, or actually wild is not certainly known) inhabits the almost inaccessible cliffs of the Rock of Gibraltar, where they are strictly preserved by the authorities. They are much more abundant in the rocky districts of North Africa, where they climb about searching for worms and insects; but they will also feed on fruits.

The Baboons are the largest Quadrumana except the Anthropoid Apes. They have a compactly-formed body, their limbs are short, strong, and extremely muscular, and their callosities are hideous. Their long snout has some resemblance to that of a dog; and hence they are called *Cynocephali*, or "Dog-headed" Baboons. But they have no resemblance to dogs in their character, for though they are very intelligent, they display all the worst tendencies of mankind in a distorted and exaggerated form. They live in large companies in the mountains of Northern and Southern Africa, where they feed on the roots, fruits, worms and insects, which they find among the rocks.

The Baboon (*Cynocephalus Babuin*) figured on Plate II. fig. c. is a short-haired animal with a long tail. It is found in company with other species in great abundance in Abyssinia, Kordofan, and other countries of Central Africa. They live among the rocks, and seldom climb trees. Full-grown males attain the size of a large dog, and display great strength and courage in their encounters with other animals. The Baboon is an intelligent creature, and can easily be taught a variety of tricks.

The Mandrill (*Papio Maimon*) figured on Plate II. fig. d., and its near ally the Drill (*P. leucophaeus*) are remarkable for their short stumpy tails. They live in troops on the Gold Coast, and inhabit forests in mountainous regions, where they seek for food among the trees and rocks. The face and rump are adorned with red and blue, but this only adds to the hideous appearance of these animals. They are fairly tractable when young, but as they grow older, they become vicious and ferocious, and their great strength renders them dangerous even to their keepers, and much more so to strangers. But it is never prudent to go very near the cages and dens in menageries and Zoological Gardens.

Section II. Platyrrhini.

This section includes the Monkeys of the New World. Their nostrils are wide apart, and they have four molar teeth more than man. They differ much from the apes of the Old World. They are usually of small size, and of slender proportions, and their long prehensile tail is used to assist them in climbing. None of them possess a projecting snout, cheek-pouches, or callosities. They inhabit the great forests of South America, and are only to be found where water is plentiful.

Family Cebidæ.

(Plates II. III.)

The Black and Red Howling Monkeys (*Myctes niger*, Plate II. fig. e.; and *M. seniculus*, Plate III. fig. a.) are very similar in size, shape and habits. They measure about a foot and a half in length, without reckoning the tail. Their body is compact, their head large, and the face ornamented with a large beard, especially in the males. But they are

more especially remarkable for a drum-like enlargement of the bone of the tongue, and for the expansion of the larynx into six cavities, which receive the air when they cry out; and this produces a continuous howl which can be heard for more than a mile away. The Howling Monkeys feed on the leaves of trees, and rarely descend to the ground. If they wish to pass from one tree to another, they often suspend themselves by the tail, and swing themselves backwards and forwards till they can grasp another branch. They do not make long leaps.

The Capuchin Monkeys form another group. Among these are *Cebus Apella*, Plate II. fig. a. and *C. capucinus*, Plate III. fig. b., which are so often brought to Europe, to be exhibited in Menageries, or carried about by Italian organ-grinders, that they must be well known to everybody. They are naturally gentle, and attached to their keepers, and are by no means deficient in intelligence.

The Squirrel-Monkeys are lively little animals,

distinguished by their slender bodies and limbs, and by their long slender tail. The best known species is *Callithrix sciurea*, Plate III. fig. c., which lives in trees in Guiana. It is perhaps the prettiest of all the American monkeys, and much resembles a squirrel in its habits and movements. It passes the day in the trees, in large companies, especially frequenting the summits, where it is very active.

Family Hapalidæ.

(Plate III.)

The Marmosets have claws instead of nails on the toes of all their feet, except on the great toes of the hind feet, which resemble hands more than their

fore feet. They live in the summits of trees, and are very timid animals. The two principal genera are *Hapale* and *Midas*. The first is provided with tufts of hair in the ears, and the second has long hair round the face instead.

The Lion Tamarin (*Midas rosalia*, Plate III. fig. d.) is one of the prettiest and most elegant animals which inhabit the forests of Brazil and Guiana. These Tamarins have a reddish-yellow mane, with a golden lustre at the ends of the hairs. They leap about from tree to tree like squirrels and lay themselves flat against the branches in the same manner. Their beauty and confiding ways render them very attractive in captivity.

Sub-order II. Lemuroidea. (Lemurs.)

(Plate III.)

The Lemurs are nocturnal animals which inhabit Africa (especially Madagascar) and the larger Asiatic islands. Their form is somewhat intermediate between monkeys and cats. They are small slender animals, and the head resembles that of a fox. The great toe is opposable both on the fore and hind limbs, and all the toes, except the second toe of the hind foot, are provided with flat nails.

The best known genus is *Lemur*. We have figured the Maki (*Lemurmacaco*) on Plate III. fig. e., which is a slender animal, about the size of a cat, with fine woolly fur, and a bushy tail. During the day it hides in hollow trees, but comes out about sunset, and wanders through the woods in



Slender Loris.

troops of about thirty or forty. It feeds on fruits, small birds, eggs &c., and inhabits Madagascar.

Another species, the Slender Loris (*Loris gracilis*) is represented in the accompanying woodcut. It is scarcely as large as a squirrel, and has slender limbs, no tail, very large eyes, and long silky fur, which is dull reddish grey and yellowish brown above, but is greyish and pale yellowish on the under-surface. This charming little animal inhabits the forests of Southern India and Ceylon, and Blanford states that the eyes are a favourite prescription with the Tamil doctors for diseases of the eyes. It sleeps in hollow trees by day, coming out in the evening to feed on leaves, fruits, insects &c.

Order II. Dermoptera. (Flying Lemurs.)

(Plate IV.)

This Order contains only the *Galcopithecidae*, animals which have been regarded by various authors as allied to the Lemurs, the Bats, and the Insectivora. They are slender creatures about the size of a cat, with a pointed muzzle, teeth irregularly arranged, and a wide membrane which encompasses the whole animal, including the limbs and tail. This skin is covered with hair on both sides, and does not form an arrangement for flight, as in the bats, but serves rather as a parachute.

The Flying Lemur (*Galcopithecus volans*, Plate IV. fig. f.) inhabits Malacca, the Philippines, the Malayan and Sunda Islands &c. These animals vary much in size and colour, and it is still uncertain whether there are several species, or only one. They begin to grow active at night, like bats, when they crawl slowly to the tops of the trees, with the aid of their long claws, in search of fruit and insects. Large specimens attain the length of nearly two feet.

Order III. Chiroptera. (Bats.)

(Plate IV.)

The Bats are frequently placed near the Apes, an account of their resemblance to them in general form, notwithstanding the difference in their organs of locomotion. Like the Apes, also, they have two teats placed on the breast. Bats do not fly like birds,

by means of feathers, and air-channels in the bones, but owe their extreme swiftness of flight to a skin which spreads between the enormously-lengthened fingers of their front limbs, and extends between their front and hind extremities, and between the latter

and the tail. The Bats have a perfectly regular set of teeth of the three usual kinds, resembling the teeth of the Insectivora. They have all large ears, furnished with various kinds of appendages. Many species are provided with similar excrescences on the nose. The neck is short and thick, the mouth wide, and the large muscles of the chest are enormously developed. All their senses are very acute, especially that of touch.

At the approach of twilight, they come forth from their hiding-places, some earlier and some later, to perform their rapid evolutions in the air; and they devour immense quantities of insects during the night. A few species only feed on fruits. When cold weather sets in, some migrate southwards, but most of our indigenous species pass the winter in caves and clefts, where they may sometimes be seen hanging by hundreds together in a state of torpor.

The Bats have been divided into many families, several of which are represented on our plate.

The Fruit-eating Bats (*Pteropidae*) are found in Eastern Africa and Southern Asia. They fly about at night, and feed on sweet and juicy fruits, often doing much damage. By day they sleep suspended to the branches of trees by their hind limbs. They are generally called Flying Foxes or Flying Dogs, from the resemblance of their heads to those of these animals.

The largest of all the Bats is the Great Kalong (*Pteropus edulis*, Plate IV. fig. a.) which measures more than a foot in length, and four feet or more across the wings. The muzzle is pointed, and resembles that of a dog. The membrane is deeply concave between the hind legs, whereas in the common Bats it forms a kind of pocket. The tail is entirely wanting. It is very abundant in the Indian islands, and very destructive to orchards.

Some American bats are in the habit of sucking blood from animals which they find sleeping by night; and this habit is generally attributed to the Brazilian Vampire Bat (*Vampyrus spectrum*) figured on Plate IV.

fig. b., as a representative of the family *Philostomidae*. It hides in clefts and caverns by day, but by night it flies round trees in search of insects and fruits. It is said to attack birds and beasts, and to suck their blood from a small wound. Whether it really possesses this habit, or whether the injury inflicted by other Bats which certainly indulge in it, has been erroneously attributed to this species, as the largest found in the country, is perhaps still uncertain. It measures six inches in length, and two feet or more across the wings.

The Great Horse-Shoe Bat (*Rhinolophus ferrum-equinum*, Plate IV, fig. e.), our representative of the *Rhinolophidae*, is tolerably common in Europe. It is remarkable for the curious projection on the nose, in which a horse-shoe proper, besides a longitudinal ridge and a lanceolate point may be traced. This species measures two inches and a half in length, and the wings expand upwards of a foot. The Horse-Shoe Bats are the nearest European representatives of the Brazilian Vampire. On account of their short wing-membrane, their flight is less rapid than that of other Bats.

The *Vespertilionidae* have no excrescence on the nose, but there is a raised leaf-like expansion on the inside of the ears, which in some species are connected together. Their senses of hearing and touch are very highly developed; and their flight is rapid and well-sustained. They feed entirely on insects. Most European bats belong to this family.

The Noctule (*Vesperugo noctula*, Plate IV. fig. c.) is very widely distributed over Europe, Asia and Africa, except in the high north. It is a common species in England, and measures about three inches in length.

The Long-eared Bat (*Plecotus auritus*, Plate IV. fig. d.) is common in England, and may easily be recognised by its enormously long ears, with an inner tongue-like fold. It does not appear till rather late at night, and flies high, but not so rapidly and easily as the last species mentioned. It is also rather smaller.

Order IV. Insectivora. (Insect-Eaters.)

(Plate X.)

The Insect-eating Mammals are small animals, of a compact and comparatively robust shape. The snout is frequently produced into a sort of proboscis, and the teeth are always regular, and extremely sharp. The limbs are short, but the tail is often long. They are not remarkable for their intelligence. They live a retired life in holes and other hiding places, but some frequent the water, while others again are found on trees. In cold and temperate climates they generally sleep through the winter, but in warmer climates they are always active. They are very useful animals, which destroy immense numbers of insects, snails &c., and they should therefore to be encouraged and protected.

The Hedgehogs (*Erinacidae*) are stout slow-moving animals with strong teeth, very short legs, an obtuse tail, and a skin on which the hairs are more or less converted into stiff spines. They are able to roll themselves up into a ball when alarmed, by means of strong muscles. They feed by night on insects and small birds, as well as on fruits and roots, but they sleep by day, and through the winter.

The Hedgehog (*Erinaceus europæus*, Plate X. fig. c) is an inoffensive animal measuring about ten

inches in length. The female is rather larger and stronger than the male. It has a small head with a long snout, and short, broad ears, a defensive suit of armour formed of strong sharp spines, covering the whole body except on the belly, and short legs, with five toes armed with sharp claws. It is very timid, and rarely emerges from its hiding place till late in the evening. It generally takes up its abode either in thick bushes, in a hole, or in the cleft of a rock. It relies chiefly on its senses of smell and hearing in its search for the insects, mice, birds &c. on which it feeds, for its sight is weak, and its sense of feeling remarkably dull.

In the *Soricidae*, or Shrew Mice, the head is long, the teeth are regular and sharply-pointed, the body is slender, and the tail long. They are found in all parts of the world, and burrow, run, climb or swim well, according to the requirements of their mode of life. They feed on insects and other small animals. Although they much resemble mice in size and shape, they have no real relationship to them, as the true mice belong to the Rodentia, a very different Order of mammals.

The Shrew-mouse (*Sorex vulgaris*, Plate X.

fig. f.) is the smallest of all known mammals, measuring only about two inches and a half in length, including the tail, which is one-third of the length of the body. But it is not inferior to the other Shrew-mice in courage and voracity. It is found in all the countries which are washed by the Adriatic Sea.

The Water-Shrew (*Crossopus fodiens*, Plate X. fig. e) is remarkable for its great activity and its elegant movements both in the water and on land. It is three inches in length without the tail, which is nearly as long as the body. Its soft fur is black above and white beneath. The undersurface of its toes is furnished with long stiff hairs, which spread out in the water, and greatly assist it in swimming.

The *Talpidae*, or Moles have a head produced into a long snout, and not separated from the body by a narrower neck. The tail is either very short,

or wholly absent. The legs are short, and the fore legs are specially adapted for digging. Their eyes and external ears are extremely small, but their hearing is good, and their senses of touch and smell still better. They dig galleries in the earth in search of worms and insects, and cast up small hillocks in the process.

The common Mole (*Talpa europæa*, Plate X. fig. g.) is an extremely quarrelsome and voracious creature, which cannot even tolerate the presence of the female except during the pairing season. It has always been a disputed point as to whether the mole was an injurious or a beneficial animal, and in some countries it is protected, and in others persecuted. The Mole is common in most parts of Europe, but it is somewhat strange that it should be absent from Ireland.

Order V. Carnivora. (Flesh-Eaters.)

No order of animals exhibits so perfect an adaptation of structure to habits as the *Carnivora*. They all possess symmetrical bodies, a powerful set of pointed and cutting teeth, and four or five toes on each foot, furnished with strong claws. In most cases, all the organs of sense are equally well developed, but sometimes one sense surpasses the others in acuteness. The *Carnivora* are strong and intelligent, and feed chiefly on other animals, which they overcome by their combined strength, craft and cunning. They also feed occasionally on vegetable matters.

Family *Felidæ*. (Cats.) (Plates VII. VIII.)

This family is the most typical and highly developed of the whole Order; and all the animals which are included in it exhibit a structure similar to that of the common cat. The head is large, and the eyes oblique, with a long pupil, which widens with the increase of darkness. The projecting upper lip is provided with a fringe of strong bristles, called vibrissæ (or, more popularly, whiskers) connected with fine nerves which render them delicate organs of touch. The teeth are strong and sharp, especially the canines. The body is long, and the skin, which lies very loosely over the body, is clothed with soft hair; some species are provided with a mane. The legs are very powerful, and the feet are armed with retractile claws. The tail is long, and sometimes tufted. Their tread is light and inaudible. They feed chiefly on birds and mammals. Their senses are all well developed, especially sight and hearing. They are distributed over the Old and New Worlds; but all Cats like warmth.

The Lion and Lioness (*Felis leo*) are represented on Plate VII. figs. a. and b. The Lion, though not quite so large as the largest Tigers, is a majestic animal, and his mane makes him appear larger than he really is. However, the mane differs considerably in length in different individuals. The largest lions measure nine or ten feet in length from the snout to the end of the tail, and stand nearly four feet high. The body is compact, the chest full and broad, and the legs very strong. The colour is tawny, and the long flowing mane which extends over the neck, shoulders and chest, is blackish. The end of the tail is also ornamented with a blackish tuft. The lioness is rather smaller, and is maneless; and very young lions exhibit traces of spots.

The Lion reigns supreme throughout the continent of Africa, where his imposing presence and terrible roar strike terror into all animals. In Asia, he is confined to the south-west, and extends as far as India, where he is rare. He inhabited Greece during historic times; and there is little doubt that he must have been common in the greater part of Central and Southern Europe at a somewhat earlier period.

The Tiger (*Felis tigris*, Plate VII. fig. c.) is more slenderly formed than the lion, but fully equals him in size. In fact, very large specimens have been stated to measure twelve feet in length. He is much more savage and dangerous than the lion, and equally strong. Many more human beings fall victims to tigers than to lions, especially to those which happen to have acquired a taste for human flesh, and seek it habitually as their favourite food. Such tigers are called "man-eaters", and are the pests of the neighbourhood which they infest, until they are hunted down and killed. The tiger inhabits the greater part of Southern Asia, and the islands of Java and Sumatra. His range extends to the north in Eastern Asia as far as the river Amoor, on the frontiers of China and Russia. The winter in this region is very severe, and the tigers which are there met with are more thickly furred than those of Southern Asia.

The skin of the tiger is soft and loose, and the colour is reddish, with black stripes; the under parts are white. The head is round, and the cheeks are ornamented with a greyish-white beard, which is more developed in the male than in the female. The tail is not tufted. Notwithstanding the conspicuous character of the colours of the tiger, they are said to harmonise so well with the prevailing hues and lights and shadows of the jungles which he inhabits, that he is sufficiently well concealed from his prey.

One of the most beautiful cats of the Old World is the Leopard, or panther (*Felis pardus*, Plate VIII. fig. a). He is common throughout Africa, Southern Asia, Ceylon, Java &c. The ground-colour is a fine reddish or yellowish, shading into white beneath, marked all over with black rings. His shape is elegant, and his movements are extremely light and graceful. He is one of the most crafty animals of the catkind. Black leopards are occasionally met with, in which the spots are almost lost in the dark ground colour; they are most common in Java,

The leopard varies considerably in size, but large specimens do not exceed 7 or 8 feet in length. He is a tree-climbing animal, and feeds on birds, monkeys &c.

The largest and most formidable of the American *Felidae* is the Jaguar (*Felis onca*, Plate VII. fig. d). He inhabits the whole of South America, except perhaps the extreme south; as well as Mexico, and some of the bordering districts of North America. He prefers thick forests, especially in the neighbourhood of rivers, where he feeds on animals which come to drink. He much resembles the Leopard in his markings, but considerably exceeds him in size. He is a very destructive animal, and is much dreaded by the inhabitants in neighbourhoods where he is common.

The Puma (*Felis concolor*, Plate VIII. fig. b) is sometimes called the American Lion on account of his tawny colour, but he is white beneath, and has no mane. He is a sleek slenderly-formed animal, with a comparatively small head with greyish markings, strong paws also varied with white, and a slender tail, without a tuft. He is a much smaller and weaker animal than the Jaguar, which is sometimes not much inferior in size to the Tiger of the Old World. He feeds chiefly on small animals, but is very destructive to sheep, of which he will destroy a large number in a single night.

The Lynxes, which some writers consider to form a separate genus, are distinguished from the other Cats by their short tail, and the peculiar tufts on their ears. They are found in many parts of the world, but in Europe they are now restricted to thinly-populated and mountainous regions.

The European lynx (*Felis lynx*, Plate VIII. fig. c) inhabits the greater part of Europe and Northern and Central Asia, as far as the Himalayas. Its fur is soft and thick, and it varies very much in colour, but is usually of a more or less reddish grey, with darker spots; the undersurface of the body is generally white. The head is surrounded with thick greyish-brown hair, varied with white, and the ear-tufts are black. It hides itself in woods among the trees and rocks, and feeds on small animals and birds. When it attacks a flock of sheep or goats, it is often as destructive as the American Puma.

The true Cats are the smallest of the family *Felidae*, to which they have given their name. Their ears are not tufted. They are not found in America or Australia.

The Wild Cat (*Felis catus*, Plate VIII. fig. d) is distinguished from the domestic cat by its generally larger size (about three feet from the tip of the nose to the end of the tail); its thicker fur, and especially by its short thick tail. The male is grey, and the female yellowish. A black stripe runs down the back, from which dark stripes descend on the sides and tail. The undersurface of the body is paler; and the throat is yellowish white.

The Wild Cat is a fierce and untameable animal, which inhabits forests throughout Europe and Northern Asia; in Southern Asia it is replaced by other allied species. It feeds on small animals and birds. In the British Isles it is very nearly extinct; for though the Common Cat often runs wild, it is not the same species as the indigenous Wild Cat.

The Common Cat (*Felis domestica*, Plate VIII. fig. c) is too well known to need description, and varies very much in size and colour. Some specimens equal if not exceed the Wild Cat in size. The Cat is a very sociable and intelligent animal, and is com-

monly supposed to be more attached to its abode than to the family with whom it resides.

Family **Hyænidæ**. (Hyænas.)

(Plate IX.)

The Hyænas have a large head and thick neck, oblique eyes, and a bristly body, with a stiff mane on the back. The front legs are longer than the hind ones; and this causes the body to slope from front to back. All these peculiarities combined render the Hyæna a peculiarly repulsive-looking animal. There are three very similar species, which inhabit Asia and Africa. They are cowardly, skulking creatures, but very greedy, and they feed on the flesh of animals which they find dead, as well as on those which they are able to kill for themselves.

The commonest species is the Striped Hyæna (*Hyæna striata*, Plate IX. fig. a). It is common in Northern Africa, and throughout South-Western Asia to India. It measures about five feet in length, of which the tail occupies 18 inches. It is of a yellowish white or grey colour with dark transverse stripes; its ears are naked and erect. It lives chiefly on carrion, and when it attacks living animals, it always avails itself of the darkness of night.

The Spotted Hyæna (*Crocota maculata*, Plate IX. fig. b) is a larger and stronger animal than the last, and when pressed by hunger, far more dangerous, although carrion forms its ordinary food. The colour of its bristly hide is a dirty yellowish grey, with brown spots on the sides and legs. This animal is abundant throughout Southern and Eastern Africa.

Family **Viverridæ**. (Civets.)

(Plate V.)

The Civet Cats and Ichneumons are all comparatively small animals, differing from the true Cats in their shorter legs, longer body, and more pointed muzzle.

The Common Genet (Plate V. fig. a) is a yellowish grey animal, with dark patches, which is domesticated in Southern Europe like a cat to destroy rats and mice &c. It measures 18 inches in length, without the tail.

The Ichneumon (*Herpestes Ichneumon*) was one of the sacred animals of the ancient Egyptians. It preys upon small mammals and birds, but also destroys snakes and crocodile's eggs. Its dark colour harmonises well with that of dry reeds and grass. It measures upwards of three feet in length, including the tail. We have figured a similar but rather larger species, *Ichneumon galera*, the Swamp Ichneumon (Plate V. fig. b) which is also a native of Africa.

Several species of Ichneumon are found in India and the adjacent islands, where they are generally termed Mongoose. They are considerably smaller than the African species, but render equal service to man by destroying rats, snakes and other vermin, and are easily tamed. They are said to derive their name from a plant called "Mungo", which they seek out as an antidote when bitten by snakes; but this story is now generally regarded as a fable. One species of Mongoose, *Herpestes javanicus*, a native of Java, is figured on Plate V. fig. c.

Family **Canidæ**. (Dogs.)

(Plates IX. X.)

Most dogs have a rather small head, a pointed snout, a slender body, contracted at the loins, slender legs, and small paws, the fore paws furnished with

five blunt claws, and the hind paws with four. The claws are not retractile, and the tail is generally rather short and sometimes bushy. Their senses are highly developed, especially those of smell and hearing. They excel in burrowing, coursing and swimming, and they are highly intelligent. They are not confined to a flesh diet, like the cats, but will sometimes feed on vegetable matters, and the tame dog will eat anything. They are found all over the world.

Dogs and wolves have a long skull, a projecting muzzle, and the pupils of their eyes are round. Their sense of smell is very acute, and by this they track their prey. They feed on the flesh of mammals, birds and fish, and appear to have a strong taste for carrion. They have all a great liking for company, and the wild species assemble in large packs. The dogs, unlike the hyænas, usually hunt their prey by daylight.

The Dog (*Canis domesticus*) is the type of the family. To this species all our tame dogs, however different in size, shape and character belong. They all resemble each other in their affection for man, and their liking for his society. They were among the first animals which man succeeded in taming, and have been in constant companionship with him from times long anterior to the dawn of history. They are among the most highly intelligent of all animals, being gifted with quick perception, and a considerable amount of understanding. Their bodily powers are likewise considerable; their swiftness is only equalled by their endurance, and their strength

by their sagacity, and thus they are able to make themselves very useful to their masters. In the East, where the dog is not taken into companionship, large troops wander about the towns, and join the vultures in acting the part of scavengers.

The Greyhound (Plate IX. fig. c) is only valued for hunting, especially in grassy places. His form is well adapted for speed, and he may easily be recognised by his long slender body and legs, his long pointed muzzle, his large chest, and narrow loins. His sight and hearing are very acute, but his sense of smell is not so highly developed as in some of the other dogs. The different varieties of Greyhounds vary much in size. The tail is carried curved up at the extremity.

The Pointer (Plate IX. fig. d) is a strongly-built dog of moderate size; the skull is arched, the ears long and drooping, and the tail long and broad. The colour differs much. These dogs are trained to track birds, and to call their master's attention to them by bending one of their fore legs.

The Wolf (*Canis Lupus*, Plate IX. fig. e) has a bushy drooping tail, whereas a dog often carries

his tail upright or curled, generally towards the left side. The wolf's head is broad and thick, his eyes are oblique, and his short ears are erect. His lithe body is slenderer at the loins. He measures about four feet and a half to the end of the tail, and stands considerably over two feet in height. His colour is a mixture of yellow, grey and brownish red. Notwithstanding his great strength, he is a cowardly creature, and never risks his life unless pressed by extreme hunger. His voice is a frightful howl. He inhabits thick forests or desolate wastes, and is found throughout Europe, North Africa, and Northern and Central Asia. He has been extinct in the British Islands, where he formerly abounded, for nearly two centuries.

The Jackal (*Canis aureus*, Plate X. fig. a) much resembles a dog with a bushy tail tipped with long hair, and measures about three feet and a half in length, including the tail. The head is intermediate in form between that of the dog and the wolf, and the tail hangs down nearly to the ground. The colour is greyish yellow, varied with black on the back, and the undersurface is reddish yellow. The Jackal is more of a nocturnal animal than the wolf, and in this, he resembles the fox, whose place he

fills in Eastern countries. He inhabits South-Eastern Europe, North Africa and South-Western Asia as far as Ceylon. He is distinguished from the fox by his long slender snout, the long oblique pupils of his eyes, and his longer tail, with longer and more bushy hair.

The Fox (*Vulpes vulgaris*, Plate X.

fig. b) has been proverbial for his slyness, cunning and audacity, from the earliest times. He is found throughout the northern parts of the world. He is not particular about his food, but will eat anything he can get. He generally spends the day in a burrow which he has either dug for himself or appropriated, and does not set out on his predatory excursions till dusk.

The Arctic Fox (*Vulpes lagopus*) is found in the regions near the North Pole. He is grey in summer, and white in winter. He lives in troops, like the wolf and jackal, and thus differs from our Common Fox, who prefers a solitary life. He is rather smaller than the Common Fox.

Family **Ursidæ.** (Bears.) (Plate XI.)

The Bears have a large head, a rather broad muzzle, short ears, and small eyes. Their thick hair makes them look larger than they really are. Their feet are armed with five strong claws, which are not retractile. Their canine teeth are large, and the molars are furnished with blunt protuberances. This



Arctic Fox.

shows that the Bears are not confined to an exclusively carnivorous diet. Their senses of smell and hearing are well developed.

The Bears generally live singly, but are sometimes met with in small companies. They are found in Europe, Asia, and North America.

The Black Bear (*Ursus americanus*, Plate XI. fig. a.) inhabits the thick forests of North America, especially near the banks of rivers. He is generally looked upon as a harmless creature, and as much less formidable than the Brown Bear of Europe, although he equals him in size. The American Bear is shining black, with only a little yellow skin on the sides of his muzzle. His head is more pointed, and the soles of his feet are shorter than in the European Bear.

The Brown Bear (*Ursus arctos*, Plate XI. fig. b) measures upwards of five feet in length, and three in height. His muzzle is conical, and clothed with shorter hair than the rest of his body. He is covered with long shaggy brown hair, but his colour varies a little according to age and locality. When young, he feeds chiefly on vegetable food, but as he grows older, he becomes dangerous to wild and tame animals of all kinds, and makes himself a pest to the neighbourhood. Bear-hunting is dangerous, but very profitable, for the flesh is considered a dainty and the hide is also valuable. At present the Bear is rarely met with in Europe except among high mountains. In Roman times, British bears were much prized in the amphitheatre for their strength and ferocity; but they became extinct in England about the time of the Norman Conquest.

The Polar Bear (*Ursus maritimus*, Plate XI. fig. c) may be distinguished by his long body, conical head, and the web between the toes of his great broad feet. He is white in colour, and a fullgrown animal is much larger and heavier than the largest Brown Bear.

The Polar Bear only inhabits the icy coasts of the Arctic Ocean, but is often drifted far to the south on floating icebergs. Although he looks so bulky, he can run very fast, and is an excellent swimmer. He is a bold animal, and his strength renders him regardless of danger. He feeds on everything which the sea and coast will furnish.

Family **Procyonidæ**. (Raccoons). (Plate XI.)

The type of this family is the well known Raccoon (*Procyon lotor*, Plate XI. fig. d) a common animal in North-America. Its broad head projects into a short muzzle, its body resembles that of a badger, and it has a broad bushy tail. The animal is about two feet long, exclusive of the tail. It generally spends the day in a hollow tree, and does not go in search of food till nightfall. When it is not hungry, it has the peculiar habit of washing all its food with its fore paws before eating it.

Family **Mustelidæ**. (Weasels.) (Plates V VI. XII.)

The *Mustelidæ* or Weasels are found in all parts of the world, except Australia. They are generally small or moderate-sized animals, with a small head, a long slender body, short legs, very sharp teeth, and non-retractile claws. Their fur is close and fine. There are glands near the tail which emit a very offensive odour. They are found in lonely forests, as well as in the neighbourhood of

human dwellings. They are very active and graceful in their movements, and generally swim with ease.

The Pine Marten (*Mustela martes*, Plate V. fig. d) is found throughout Europe, as well as in some parts of Northern Asia and America. It frequents thick woods and forests, where it makes its abode in hollow trees, squirrels' nests &c. It leaps, climbs, and swims well, and is a very cunning and audacious robber, from which no weaker animal is secure. Including the tail, the Pine Marten measures fully two feet and a quarter in length. Its fine soft fur is dark brown above and yellowish on the back and sides.

The Beech Marten (*Mustela foina* Pl. V. fig. e) is smaller; the head is longer and the chestnut-brown fur is shorter. The neck and chest are white. The Beech Marten likes to make its abode in old walls and barns, and is therefore more often found near human dwellings than the Pine Marten. It can be tamed when taken young, but is less frequently kept in confinement than the Ferret.

The Weasel (*Mustela vulgaris*, Plate VI. fig. a) is brown above, and white beneath. It is not much larger than a rat, but it is a very courageous animal, and will not only attack animals of its own size, but very much larger ones, with the greatest audacity. Its small lithe body enables it to make its way not only among the woods and fields, but to creep through any hole or crevice in outhouses and farm-yards.

The Stoat or Ermine (*Mustela erminea*, Pl. VI. fig. b) is nearly twice as large as the Weasel, but much resembles it in its habits. It is brown in summer, but in the cold winters of Northern Europe and Asia, it becomes pure white in a few days, except the tip of the tail, which always remains black. The Stoat climbs and swims well, and will even cross running water.

The Sable (*Martes zibellina*, Plate VI. fig. d) much resembles the Beech Marten, but the head is more pointed, the ears longer, and the tail shorter. It is met with throughout Northern Asia, but is now getting scarce, owing to the value set upon its soft shining fur. This is prized in proportion to its uniformity of colouring, the finest specimens being blackish on the back, with the undersurface of the body reddish brown.

The Pole-cat (*Putorius fatidus*, Plate V. fig. f) is smaller than the martens, but far more destructive to game and poultry, as it will kill much more food than it can eat. It is not so slender as the Martens, and its outer fur is darker than the inner. When alarmed or wounded, it emits an exceedingly offensive odour.

The Ferret (*Putorius furo*, Plate VI. fig. c) is very similar to the Pole-cat, and is by many writers considered to be only a variety of it. It is an inhabitant of North Africa, but is employed in Europe to pursue rats and rabbits in their burrows. It is generally of a white or pale yellow colour, with red eyes.

The most formidable of all the weasel tribe is the Skunk (*Mephitis chinga*, Plate VI. fig. e). It is about a foot and a half long, not including the tail, which is not much shorter than the rest of the body, and very bushy. The fur is black, sprinkled with white, long and shining, and of some commercial value. Although not so slender as the other weasels, and less active, it is a very pretty animal, but has the peculiarity of defending itself when attacked or alarmed, by ejecting an unsufferably fetid secretion

over its pursuers; an odour which it is scarcely possible either to endure or to eradicate. Nor is this all, for the fluid is said to produce blindness if it comes in contact with the eyes, while the bite of a skunk produces a disease very similar to hydrophobia. This inoffensive-looking, but highly dangerous animal is common in North America.

The Glutton or Wolverine (*Gulo luscus*, Pl. XII. fig. a) much resembles a small bear in appearance, but is really a large bulky marten, with a large broad short neck, compact body, an arching back, and short strong legs. The feet have five toes armed with strong claws, and the tail is short and bushy. It measures upwards of three feet in length, including the tail. It inhabits the northern parts of Europe, Asia and North America, where it not only feeds on small mammals and birds, such as the lemming and ptarmigan, but destroys large animals like the elk and reindeer, leaping on them from the branches of a tree. Its shaggy fur is valuable.

The Badger (*Moles vulgaris*, Plate XII. fig. b) has a long pointed head, with small eyes and ears. It is smaller than the Glutton. The Badger is a sluggish morose animal, and lives a solitary life in a burrow in the ground, except during the pairing season, about the beginning of December. Here it sleeps through the winter, with some interruptions, and here too it passes most of the day during the

summer, but at night it sallies forth to the woods and fields in search of its food, which consists of all kinds of small animals, in addition to vegetable substances. The Badger inhabits Europe, and a large part of Northern Asia.

The Otters are long-bodied animals with short legs, and smooth shining fur, a broad flattened head, short tail, and webbed feet.

The Common Otter (*Lutra vulgaris*, Plate VI. fig. f) is common throughout Europe, and a considerable portion of Northern and Central Asia. It measures two feet in length, without the tail, which is half as long again. It is very fond of trout-streams and rivers flowing through woods, and is an excellent swimmer and diver. It feeds chiefly on fish, of which it destroys large quantities. When taken young, it is easily tamed and shows itself to be an intelligent animal.

The Sea-Otter (*Enhydra lutris*, Plate VI. fig. g) has a cylindrical body, a short thick neck, and a round obtuse head. In external appearance it is not unlike a seal. The toes and webs are less developed on the fore feet than on the hind feet. The tail is short, clothed with thick fur, and trails along the ground. The Sea-Otter grows to twice the size of the common Otter. It is found on the coasts and islands about Behring's Straits, but its fur is so much prized that the animal is now becoming very scarce

Order VI. Pinnepedia. (Seals.)

(Plate XXVIII.)

The Seals are the marine representatives of the *Carnivora*, and are often regarded as a mere section of that Order. They are large animals, with cylindrical bodies, and their limbs and tail are more or less shortened, and are adapted for swimming, being provided with but few joints. Their carnivorous teeth, large eyes, and the occasional presence of external ears, as well as their intelligence, show them to be comparatively highly-developed mammals, notwithstanding the shortness and peculiar form of their limbs, which are intended to be used as paddles. Their proper abodes are the waters of the sea and the mouths of rivers, but they are helpless animals on land, which they only visit to sleep and sun themselves, or to rear their young.

The Seals are gregarious animals, and congregate in large numbers. They are found in most coasts, but are most numerous on the coasts and uninhabited islands of the Polar Seas, but are far less abundant than formerly, owing to the constant persecution which they have suffered.

The Common Seal (*Phoca vitulina*, Plate XXVIII. fig. a) may be taken as the representative of the *Phocidæ*, or true Seals. It has a rounded head, with a dog-like muzzle, with bristles round the mouth, a short neck, a cylindrical body, and nails on its toes, which latter are connected together by a folded web. It measures 5 or 6 feet in length. The smooth furry hide is of a greyish brown sprinkled with yellowish brown, and dirty white beneath. This animal inhabits the seas and coasts of the North of Europe, including the Baltic.

The *Trichechidæ* or Walruses are remarkable for the structure of their teeth. Full-grown animals have six molar teeth in the upper and lower jaws, two small canine teeth in the lower jaw, and two very large ones in the upper jaw, which have crowded

out the incisors originally present, and project from the mouth as long tusks. They are sometimes more than two feet long, and the animal uses them to stir up the ground, as well as to drag along its unwieldy body on the ice, by using them as grapnels.

The Walrus (*Tricheccus rosmarus*, Plate XXVIII. fig. d) inhabits the Arctic Ocean, and lives in herds. The head is rounded, and comparatively small, though armed with formidable tusks. The neck is as thick as the head, and the body is thickest in the middle. The legs are converted into large flippers. The skin is extremely thick, and is at first covered with dark hairs, but in older animals is naked, and greyish white. When the Walrus is not interfered with, it is a lazy and sluggish animal, but it will boldly defend itself and its young when attacked. All parts of this animal are useful; the hide, the flesh, the fat (or blubber, as it is called) and especially the ivory tusks.

The *Otariidæ* are distinguished from the true Seals by possessing short external ears.

The Sea Bear (*Calirhinus ursinus*, Pl. XXVIII. fig. b) has a longer neck than the common seal, and the limbs stand out further from the body. It grows to the length of seven or eight feet. It is covered, except on the flippers, with long coarse hair, blackish above, and yellowish-grey beneath. The front part of its body somewhat resembles that of a bear in appearance.

The Sea Lion (*Otaria jubata*, Plate XXVIII. fig. c) well deserves his name, for his rounded head, thick lips, and long whiskers, combined with the yellowish colour of his fur, and the long black hair on the mane of the neck of the male, give him considerable resemblance to the king of beasts. In other respects he is very like the Sea Bear, but is

much larger, sometimes nearly as large again, his front limbs are longer in proportion, and the hair, with the exception of the mane, is considerably shorter. Both these animals inhabit the shores of

Behring's Straits, and were formerly very abundant on Behring's Island; but the Sea Lion is now getting scarce, though the Sea Bear is still common there.

Order VII. Rodentia. (Gnawing Animals.)

(Plates XII—XIV.)

The most remarkable peculiarities of the Rodents, or Gnawing Animals, consist in the two large curved incisors in the upper and lower jaws, and in the gaps between these and the molars. The head is planted on a short thick neck, the large eyes are very prominent, and the fleshy lips are furnished with whiskers, and are cleft in front. The senses of these animals are usually well-developed, but they are not generally remarkable for intelligence.

The *Hystriidae*, or Porcupines, are rather large Rodents, furnished with strong spines, which are differently arranged in different species. They inhabit the warm and temperate parts of both the Old and the New Worlds. Some have short tails and dig burrows in the ground, and others have short tails and live in trees. All the Porcupines are nocturnal animals, and feed on fruits and roots.

The Common Porcupine (*Hystrix cristata*, Plate XII. fig. e) is about three feet long, and stands a foot high without the spines. It has a long mane of stiff bristles on the back of the neck, and the back and sides are covered with spines, mixed with bristles. It is found in North Africa, Greece, and Southern Italy. It conceals itself in its burrow by day, but comes forth at night to search for the roots on which it feeds.

The *Caviidae* have comparatively large ears, a stumpy tail, and broad hoof-like claws. They are found in South and Central America, some species being exclusively land animals and others frequenting the neighbourhood of water.

The Guinea Pig (*Cavia cobaya*, Plate XII. fig. f) does not come from Africa, but from South America, and is domesticated in Europe. It has not yet been positively ascertained, from which of several closely-allied wild species it was originally derived.

The type of the family *Dasyproctidae* is the Agouti (*Dasyprocta aguti*, Plate XIII. fig. a). It is very like a hare, but differs from it by its long pointed muzzle, short ears, and the structure of the legs. The front legs are short, and have four toes, but the hind legs are twice as long, and are provided with three toes. The claws are long, thick, and almost hoof-like. The rough shining hair is of a reddish yellow, intermixed with dark brown. The Agouti is common in many parts of South America, and is very shy, wary and active. It feeds on fruits, roots, leaves &c.

The *Arctomyidae*, or Marmots, are stout-bodied short-tailed Rodents of moderate size. They dig burrows and chambers in the ground, which they store with grains and roots, and they sleep through the greater part of the winter. During the warmer months, they play about their burrows in company, and feed on worms and insects, as well as on vegetable substances. They are shy and wary in a state of nature, but are easily tamed. They are found in Central Europe, Northern Asia and North America.

The Marmot (*Arctomys marmotta*, Plate XIII. fig. c) is found in the high mountains of Europe such as the Alps, Pyrenees and Carpathians, close to the limit of perpetual snow. In summer it is watched

for, and shot, and in winter it is dug out of its burrows. The flesh is delicate, and the fur is soft and warm.

The *Sciuridae*, or squirrels are among the most active and elegant of the Rodents. The body is slender, the eyes are large and the ears are very variously formed. The tail is rather long and very bushy, and the hind legs have five toes, and are longer than the fore legs, which have only four toes. Squirrels may generally be seen in the daytime, but a few are nocturnal in their habits. They either frequent trees, or live in burrows in the ground.

The Squirrel (*Sciurus vulgaris*, Plate XIII. fig. d) is an ornament to the woods and forests of Europe, and of some portions of Northern and Central Asia. The tufts on the ears, and the bushy tail give this animal a very pretty appearance. When he sits on his hind legs, he holds his tail raised over his back. He is as good a climber as a monkey, and leaps from tree to tree, balancing himself with his tail. Squirrel's nests resemble those of magpies, and are built in hollow trees. Here the animal sleeps at night and on rainy days, as well as through the greater part of the winter, for which, however, like the marmots, he lays in a store of provisions beforehand.

The *Myoxidae*, or Dormice offer a great contrast to the lively squirrels, for they are nocturnal animals. They hide themselves by day in hollow trees and in the clefts of rocks, and feed at night on seeds and fruits. They all inhabit the Old World, chiefly in temperate climates.

The Loir (*Glis vulgaris*, Plate XIII. fig. e) is not uncommon in Southern and Eastern Europe, and prefers dry oak and beech woods. It measures nine inches in length, of which the tail forms nearly one-half. This animal is ashy grey, with the sides paler, and the undersurface white. The tail is rather bushy, and the hairs are arranged in a double row.

The Rats and Mice belong to the family *Muridae*. They have a pointed muzzle, large eyes, and broad ears, and some are furnished with cheek-pouches. The body is generally long, and clothed with smooth hair, and the tail is long or short, hairy or naked in different species. The legs are slender, furnished with five toes, and armed with sharp claws.

Mice are found in all parts of the world. They are cunning and comparatively intelligent animals.

The Hamster (*Cricetus frumentarius*, Plate XIII. fig. b) is like a mouse with a rather stout body, and a short tail sparingly clothed with hair. It is about a foot long. It is of a brownish yellow colour above, and black below, yellow before and behind the front legs, and the feet white. It inhabits level country in Northern Europe and Asia where much corn is grown, and makes complicated burrows underground, where it lays up a store for itself which is frequently found to contain nearly from fifty to a hundred pounds' weight of grain &c. at the beginning of winter.

The Mouse (*Mus musculus*, Plate XIII. fig. g) is known to everyone as a timid and very active little creature.

The Brown Rat (*Mus decumanus*, Plate XIII. fig. h) sometimes measures nearly a foot in length, without the tail. It is greyish brown above, and greyish white beneath. It is an Asiatic animal, which has migrated to Europe, and nearly exterminated the indigenous Black Rat (*Mus rattus*). Rats and mice are very prolific animals, which feed on everything which serves for food for man, and penetrate everywhere into our dwellings and storehouses.

The long-tailed Field-Mouse (*Mus sylvaticus*, Plate XIII. fig. i) not only lives in woods and thickets, but also likes to visit human dwellings. In the country it feeds on nuts, seeds, insects and even on small birds. It is brownish yellow above, and white below, and measures seven inches in length.

The *Arvicolidae*, or Voles, are sometimes classed with the true mice, but may be distinguished from them by their large incisors, stouter body, large head, and short ears and tail. They inhabit the northern parts of both hemispheres, and live in burrows in the ground.

The Field-Mouse (*Arvicola arvalis*, Plate XIII. fig. f) is yellowish grey above, and dirty white beneath; it is rather smaller than the common mouse. It lives in fields, where it makes galleries and chambers in the ground, and lays up a store of grain, nuts &c. for the winter. But it sometimes ventures into houses too.

The *Spalacidae* or Mole-Rats are ugly animals with cylindrical bodies, small, hardly perceptible eyes, and paws formed for digging. They are very mischievous, because they burrow in the ground in all directions. They feed on the roots and bulbs of plants.

The Mole-Rat (*Spalax typhlus*, Plate XIII. fig. k) has a large head, without visible eyes or ears, which seems to pass immediately into the body, owing to the shortness of the neck. There is no tail, and the legs are furnished with broad paws and strong claws. The Mole Rat is really blind, for its eyes are very small, and covered by the skin. It is found in Hungary, Russia and part of Western Asia, and is a vicious unsociable animal.

The *Leporidae* or Hares are easily known by their prominent head, large eyes and ears, long slender body, disproportionately long hind legs and short tail. The Hares are the only Rodents which have two small rudimentary teeth in each jaw behind the two incisors.

Hares are found in all parts of the world except Australia, and feed on juicy herbs and roots. They are active and graceful animals, and seem never wearied with running. They generally live gregariously, and multiply very rapidly.

The Common Hare (*Lepus timidus*, Plate XIV.

fig. a) is nearly of the colour of the ground, and consequently the animal can easily be overlooked when it crouches down. It inhabits Central Europe, and part of Central Asia.

The Alpine Hare (*Lepus variabilis*, Plate XIV. fig. b) is rather smaller than the common hare, the head is rounder, the ears longer, the hind legs longer and the soles of the feet more hairy. When the first snow falls, the black tips of the ears turn white, but in the spring they gradually return to their usual colour. It is found in the mountainous parts of Continental Europe, and in Scotland and Ireland.

The Rabbit (*Lepus cuniculus*, Plate XIV. fig. c) is smaller and more slender than the hare, and has a shorter head and shorter ears. The hind legs, too, are shorter. The skin is usually greyish brown, and the tail is black above and white below. The domesticated varieties, however, vary much in colour. The Rabbit is very gregarious, and prefers bushy sandy places, where it digs burrows in the ground. It is more active in the evening or morning than in the heat of the day.

The Beaver (*Castor Fiber*, Plate XIV. fig. d) is the type of the family *Castoridae*. It is between three and four feet in length. The rather stout body is broader behind than before; the legs are short and strong, and the hind feet are webbed to the claws. The colour of the soft silky skin is chestnut-brown above, and lighter below. The flat, broad tail is only hairy for the first third of its length; the rest is naked, and is furnished with small furrows. The Beaver is much sought after for its fur, and for the odoriferous substance called castoreum, which is secreted in two glands near the tail. The Beaver is an amphibious animal, and generally rests in the reeds on the banks of streams or lakes. It builds its habitations which are often several feet high, in the water, and protects them by a dam. It feeds chiefly on the bark of trees which grow near the water. It is found in Europe, Asia and North America; but is now very scarce and local in Europe, and it has been so much persecuted that it is everywhere far less common than formerly.

The Musquash (*Fiber Zibethicus*, Plate XIV. fig. e) is an inhabitant of North America. Its whole appearance is stout and stunted, the head is short and round, and the neck thick. The tail is laterally compressed, cultriform towards the end, and covered with small scales. The feet and toes are webbed at the sides; there are four toes on the fore feet and five on the hind feet. The full-grown animal measures two feet in length, including the tail. It resembles the beaver in its very fine fur, which is brown above and grey beneath. The skin is valuable, but always retains a strong smell of musk.

Order VIII. Proboscidea. (Elephants.)

(Plate XVI.)

This Order only includes the family *Elephantidae*. They are very large and bulky animals; with a thick hide sparingly clothed with hair, a short body, and long thick legs like pillars, with five toes provided with small hoofs. The nose is produced into a long trunk, with a finger-like process at the end, which serves as an organ of prehension. These animals have a very short neck, but use the trunk to grasp their food, and likewise for drinking, for they fill it with water, which they then squirt down their throats.

The structure of the teeth is remarkable. The incisors are wanting in the lower jaw, and are represented by two large teeth in the upper, which have no fangs, and grow continually. There are only two existing species.

The Indian Elephant (*Elephas indicus*, Plate XVI. fig. b) is rather smaller than the African Elephant, from which it is distinguished by the more raised head, the smaller, moveable ears, and the shorter tusks. The hide is slate-colour, with blackish bristles.

This species rarely exceeds nine feet in height, when it measures about twelve feet in length; the trunk is six or seven feet long; and the tail four feet. The full-grown animal weighs 400 or 500 pounds. It is found in India and Ceylon in herds which may number one hundred individuals. It feeds on the leaves and branches of trees, which it breaks off with its

trunk. When not roused to fury, it is a quiet, harmless animal, and has been domesticated for many centuries, when it exhibits a sagacity and intelligence equal to that of the dog.

It lives to the age of seventy years, and some individuals are said to have lived considerably more than a century.

Order IX. Perissodactyla. (Rhinoceroses, Tapirs and Horses.)

(Plates XVI. XVII. XXVII.)

The *Rhinocerotidae* are inferior in size to the Elephants, but are far more ugly and clumsy. They have neither tusks nor trunk, but possess strong canines, and true incisors. Their hide is thick, wrinkled and almost naked. These animals are indolent, and very deficient in intelligence; they feed on water-plants, grass and the leaves and branches of trees. Water is indispensable to them, and they swim and dive well. They are found in Central and Southern Africa, and also in Southern Asia, but always in the neighbourhood of rivers, lakes or marshes.

The Indian Rhinoceros (*Rhinoceros indicus*, Plate XVI. fig. b) is about ten feet in length, and stands nearly five feet high at the shoulder. The head is rather long when seen in profile, and there is a long horn curved backwards, on the nose. It is fixed to the bone, though it actually consists simply of a mass of modified and compressed hair. The eyes are small, and the ears erect and like those of a pig. The thick short curved feet have four toes with hoofs. The tail is short, and tufted beyond the middle. The Rhinoceros lives in pairs, and inhabits different parts of India. The lazy creature will lie in a pool for hours, or saunter quietly on his way, but a trifle will rouse him to make a headlong charge at anything, in ungovernable fury.

The other species of *Rhinoceros* resemble *Rhinoceros indicus* in form and habits, but some have two horns on the nose instead of one.

The *Tapiridae*, or Tapirs are small in comparison to the species of *Rhinoceros* and less unwieldy in appearance, though their bodies are also stout. The long tapering head has short ears, small eyes, and the upper lip is produced into a short trunk. The neck is slender, the body like that of a pig, and the legs are short and thick, with four toes with hoofs on the fore feet, and three on the hind feet. The skin of the Tapirs is thick, and clothed with smooth hair. They have strong teeth, all three kinds being present. They pass the day in thick forests, preferring the neighbourhood of rivers and swamps, in which they like to wallow. On the approach of darkness, they roam about to seek their food, which consists of the leaves of trees, and marsh-loving plants; but they will also work havoc in cultivated fields.

The American Tapir (*Tapirus americanus*, Plate XVII. fig. a) is of a dark brown colour, paler on the sides of the head and neck, and on the breast. There is a short stiff mane on the back. The Tapir is a quiet harmless animal, which rushes into the bushes at the approach of danger, but when it is attacked in the water, it immediately dives, and swims for some distance under the surface. It resembles a pig in the greediness with which it feeds on all sorts of food.

The *Equidae* or Horses are long-legged, slenderly formed animals, and the existing species have only one toe with a large hoof. There are always six incisors in each jaw, and a considerable gap on each side between these and the molars. When the bones of the legs are examined, the comparative shortness of the upper bones is remarkable, while the bones of the foot corresponding to the middle toe are very strongly developed, and form, with the three toe-joints, the last of which bears the hoof, the sole support of the body. The head is pyramidal and flattened, the ears erect and pointed, and the muscular and rather long neck is adorned with a long flowing mane on the back. The body is shapely, the legs slender, and the short tail very hairy, either from the base, or towards the extremity. In general, the hair is short and smooth, and the colour, especially in the domesticated species, very variable. All the senses are well developed in horses, and they are gifted with considerable intelligence. In the wild state these animals are gregarious, and live together in large herds. When danger threatens, they not only use their hoofs for flight, but also for defence. They chiefly inhabit plains and plateaus, but are also found in the mountains, where they climb the narrowest paths with surefooted agility.

Plate XXVII. fig. a represents the Arabian variety of the Horse (*Equus caballus*). The true Horses are among the largest and handsomest of the family. They are distinguished from their allies by the short pointed ears, flowing mane, and the tail, which is clothed from the root with long and strong hair. These are the general characteristics of the horse, but there are great differences between the races in different countries. All are fine, intelligent animals and greatly valued by men, but one of the finest and handsomest races is the Arabian. There are enormous herds of wild horses in some parts of America, which are said to have originated from those introduced by the Spaniards. There are, however, herds of undoubtedly wild horses in Asiatic Russia. Their heads are large, and their appearance is far less handsome than that of the tame horse, though they may excel in speed and endurance.

The Ass (*Equus asinus*, Plate XXVII. fig. b) is properly speaking a Southern animal. In the South it is a beautiful and graceful creature, much larger, smoother, and more spirited than the asses seen in the North. The finest are met with in Egypt and Persia, but beautiful animals, worth almost as much as a horse, may also be seen in Spain and Southern Italy. The Ass has a longer head and longer ears than the Horse, the mane is short, and the tail is only provided with long hairs towards the tip. Hybrids between the horse and the ass are common. Those between a horse and a she-ass are called Hinnies, and those between a he-ass and a mare Mules.

The Zebra (*Equus zebra*, Plate XXVII. fig. c) and the Quagga (*Equus quagga*, Plate XXVII. fig. d) are striped horses which inhabit the plains of Southern Africa in large troops. They are intermediate between the horse and the ass in form, and are of about the size of a large ass.

The true Zebra, which is now almost extinct,

is striped over the whole body, and has most resemblance to an ass, especially as the tail has long hairs only at the end. The Quagga is not striped on the legs, the tail is hairy from the root, and the ears are shorter. In general appearance it shows a much closer resemblance to the Horse than does the Zebra.

Order X. **Arctiodactyla.** (Swine and Hippopotami.)

(Plate XVII.)

By many writers, the Ruminating Animals are placed with this group, as a section of the *Ungulata*, or Hoofed Animals, in which the *Perissodactyla*, *Proboscidea*, &c. are also included as subordinate groups. But in the present work, we have preferred to treat them separately. The restricted Order *Arctiodactyla* agrees with the *Ruminantia* in the structure of the feet, which have an even number of toes, and in the molar teeth being covered with ridges of enamel.

The *Suide*, or Swine are found in all parts of the world except Australia. The head is conical, with small eyes, moderate-sized ears, a proboscis-like, truncated snout, and the jaws furnished with all three kinds of teeth, among which the projecting canines, which are larger in the males than in the females, are very conspicuous. The body is laterally compressed, the tail thin and ringed, the legs moderately long, slender, and furnished with four hoofs. They are the most voracious of all animals.

The only wild pig found in Europe is the Wild Boar (*Sus scrofa*, Plate XVII. fig. d) from which our domestic animal (Plate XVII. fig. c) is probably derived. The Wild Boar has been extinct in England for at least two centuries, but is still found wild in many parts of Europe, Asia and North Africa. He is a strong and comparatively active animal, and is

larger than the ordinary domesticated varieties; the legs are thicker, the head larger, the snout more pointed, and the tusks longer and sharper, especially in the males. The colour is dark blackish brown. These animals inhabit thickets and marshes in small herds, and generally avoid men, but when they are enraged, they will attack any enemy boldly, and can inflict fearful wounds with their tusks. They are frequently very destructive to crops. When killed, all parts of their bodies are valuable.

The Hippopotamus or River Horse (*Hippopotamus amphibius*, Plate XVII. fig. b), the representative of the family *Hippopotamidae*, has an enormous head, a small brain, and a huge face, which is almost square. The teeth are hidden by the bulky muzzle. The great body rests on legs which are only two feet long, and are provided with four toes on each foot. The hide is naked, except that there are a few stiff bristles towards the end of the slender tail. The colour is dark brown, shading into a paler coppery hue beneath. The Hippopotamus is found in the rivers and lakes of a great part of Africa in herds of perhaps fifty individuals, but wanders out on the banks at night, where it often commits great devastation in the plantations of the natives. It is a very dangerous animal to attack.

Order XI. **Ruminantia.** (Ruminating Animals.)

The Ruminants form a rather large section of mammals. All have a comparatively small head, in which the face is much larger than the part containing the brain. The jaws are very prominent, and the dentition generally uniform. With the exception of a few families, there are 6 or 8 incisors in the lower jaw only, the canines are usually absent, and there are generally six molars on each side above and below, provided with enamel. The frontal bone is often decorated with peculiar outgrowths and bony projections, which are called horns or antlers. The feet are always provided with two separated hoof-bearing toes.

But the most characteristic feature of this Order is the division of the stomach into 3 or 4 compartments, an arrangement which allows the animals to throw up the undigested food which they have swallowed, and to chew it thoroughly, at their ease, mixing it with the secretions of various glands. This is called "chewing the cud".

Family **Camelidae.** (Camels and Llamas.)

(Plates XVIII. XIX.)

These animals form the first section of the *Ruminantia*, the *Tylopoda*. They are large animals with long necks, slender loins, padded feet and long shaggy hair. The upper jaw has only two incisors,

but the lower jaw has six, and both jaws are furnished with canine teeth as well as incisors. This small group includes only the Camels and Llamas. The former are found in North Africa and Central Asia, and the latter in the west of South America.

The genus *Camelus* has an extremely long neck, and one or two large humps of fat on the back. The division of the hoofs is only visible above, for they are united beneath into a broad sole. This enables the animal to pass rapidly over a sandy surface without sinking in.

The Camels are indispensable to the nomad tribes of the desert, both for riding, and for beasts of burden. But their usefulness and endurance are the only good qualities which they possess.

The Arabian Camel (*Camelus dromedarius* Plate XVIII. fig. a) has only one hump, which increases or diminishes in size according to whether the animal is well fed or the contrary. It stands six feet high, and attains a length of about nine feet from the tip of the muzzle to the end of the tail. It is not known in the wild state, but is probably a native of Arabia and North Africa, from whence it has been introduced into Tuscany, South Spain, Mexico, &c., where it thrives well under favourable conditions. The strong breeds used for carrying burdens are called camels, and the lighter and swifter breeds used for riding are called dromedaries.

The Bactrian, or Two-humped Camel (*Camelus Bactrianus*, Plate XVIII. fig. b) is enabled by the thickness of its hair to endure a low temperature, and replaces the Arabian Camel in Central Asia, where it is still found wild in some retired spots. Its gait is slow and heavy, and therefore it is not much used for riding, but is of great value in transporting merchandise across the steppes. It is indispensable to the Kirghises and other nomadic tribes, who obtain from it meat, milk, wool, hair, and in fact most of the necessities of life.

In the Llamas, the soles are not united, the hoofs being widely cleft; the back is humpless, the hair long and silky, the head comparatively larger than in the Camels, and the muzzle more pointed.

They inhabit the Cordilleras of South America, and being mountain animals, can only be employed at a certain height above the level of the sea. They are valuable for their flesh and wool, and the tame species are also employed as beasts of burden.

The Llama (*Auchenia Llama*, Plate XIX. fig. a) will easily and safely carry a load of one hundred pounds, and will feed on the mountain plants which it finds on the way. The full-grown animal measures four feet in height; and its colour, as is usually the case with domestic animals, is very variable. The flesh is said to be delicate, and the wool is woven into fabrics.

Family **Tragulidæ**. (Musk Deer.)

(Plate XIX.)

The second section of Ruminants, the *Tragulina*, likewise contains only one family, the *Tragulidæ*, or Musk-Deer. They are swift animals, somewhat like antelopes, without antlers or tear-channels, and the males have long canine teeth in the upper jaw. They are very shy and active creatures, which inhabit the high grounds of Central Asia and the forests of the Sunda Islands. They are hunted for their flesh and skin, and some of them on account of a pouch containing musk, which is found in the male animal.

The Musk Deer (*Moschus moschiferus*, Plate XIX. fig. b) has a short head and slender legs, with two widely-cleft hoofs, with claws behind. The skin is thick and clothed with long reddish brown hair, especially on the sides of the body. It is one of the smaller Ruminants, not much exceeding two feet in height. It inhabits Northern India.

Family **Cervidæ**. (Deer.)

(Plates XIX. XX. XXI.)

The remaining Ruminants are placed together in the group *Pecora*, and form several families, of which the first is the *Cervidæ*, or Deer. They are distinguished by the presence of tear-channels, and of antlers, which rise from two horn-cores on the forehead, and are variously branched. The horns are generally peculiar to the males, and are shed at certain seasons. The head is long, narrowed towards the muzzle; the neck is long, the body slender, contracted at the loins, and covered with hair, more thickly in some species than in others; the legs are long and slender, and there are two small hoofs on the feet, furnished with claws behind. Deer are found in most parts of the world except in Australia, and in a great part of Africa. They live in herds, some species in the plains and others in the mountains, but always in the neighbourhood of water, which is necessary to their existence. Their senses are keen,

and their intelligence considerable. They are valued for their hide and flesh, and are ranked among the principal beasts of the chase.

The Elk (*Alces Malchis*, Plate XIX. fig. c) is one of the largest of the deer tribe. It is a strange and imposing animal, which hardly seems to belong to the present age. It is unfortunately disappearing from most parts of Europe, and is now only to be met with in Sweden, Norway, and the Northern half of the Russian Empire, and is everywhere preserved. In Northern Asia it is still rather common, especially in the great forests on the banks of the rivers of Siberia. It is also found in North America, where it is called the Moose. A full-grown Elk stands 6 or 7 feet high at the shoulder. The head is rather ugly, the muzzle is broad and long, the eyes are small, and the ears are long, like those of a donkey. The neck is thick and strong, the body stout, and the legs strong, and of equal height. The full-grown male bears large shovel-shaped, jagged antlers. The hair is long and thick, the mane along the back is thicker in the male, and the colour is dark reddish brown. The hide is very durable, and the animal is hunted for this, as well as for its flesh.

The Reindeer (*Tarandus rangifer*, Plate XX. fig. a) is smaller and swifter than the elk, and has broad hoofs, almost like those of a cow, with claws behind, and both sexes are horned. The Reindeer is about as long as a large stag, but is stouter, and does not stand so high. The tame Reindeer, which are kept in large herds, are among the most useful animals known. While they live, they are employed to draw sledges and to carry loads, and to furnish milk; and when they are slaughtered, their flesh is good for food, their hide for clothing, their sinews for cord, and their bones for spoons, &c. The Reindeer is found in the most northern parts of Europe, Asia and America, where its broad hoofs enable it to run rapidly and easily across swamps and snowfields. It feeds on all kinds of alpine plants, and even on mosses and lichens, which it scratches in winter from under the snow.

The Stag or Red Deer (*Cervus elaphus*, Plate XX. fig. b) is one of the finest of the European deer. It may measure seven feet long, and stand over four feet high at the shoulder, but varies much in size. Its body and legs are slender, and its head is finely formed, and adorned with splendid antlers. The branches are round, and as in other deer, increase in number with age. The body is thickly clothed with hair, which is reddish brown in summer, but more greyish in winter and it is often of considerable length on the front half of the body. The tear-channels are strongly marked, and discharge a greasy secretion, which is exuded when the animal rubs itself against trees. The Stag is found in the greater part of Europe, and in a large part of Asia, except in the extreme north. The female is called a Hind.

The Fallow Deer (*Dama vulgaris*, Plate XXI. fig. a) is distinguished from the Red Deer by its smaller size, more slender body, shorter legs and longer tail, and also by the antlers, which are round below, but shovel-shaped and dentated above, and therefore more like those of the Elk and Reindeer. The colour of the skin is reddish brown above with white spots, and whitish beneath in summer; and dark grey above, and paler beneath in winter; but the colour varies much according to age. The finest of these animals, which are almost as great an adornment to parks and forests as the Red Deer, are frequently pure white.

The Roe Deer (*Capreolus caprea*, Plate XXI. fig. b. c) is a beautiful animal, with very expressive eyes. It has very small tear-channels, and the horns of the buck are short and forked. It stands rather more than two feet high at the shoulder. The thick smooth hair is short in summer, and of a dark rusty-red colour on the back and sides; but in winter it is long and brownish grey. The Roe Deer lives in smaller herds than the other deer, and generally in families, which are headed, and when needful, defended, by the 1d Roebuck. The flesh, the skin and the horns are used in various ways.

Family **Giraffidæ.** (Giraffes.)
(Plate XXII.)

There is only one species of this family, the Giraffe (*Camelopardalis Giraffa*, Plate XXII. fig. a). It is the tallest of all existing Mammalia, sometimes measuring nearly twenty feet in height. This is due to the unusual length of its neck and legs, for its body, though stout, is not long in proportion, and slopes from

front to back. The head is long and finely shaped, somewhat resembling that of a horse, and the eyes are large and expressive. The forehead is adorned with two protuberances, overgrown with skin. This harmless and timid animal inhabits Central and Southern Africa in larger or smaller herds, and feeds on the

leaves of the Mimosa and other trees. It has a peculiar shuffling gait, but can run with great speed when alarmed.

Family **Bovidæ.**

The large family *Bovidæ* includes several distinct groups, such as the Antelopes, Oxen, Goats and Sheep, which it will be best to treat separately.

Antelopes.
(Plates XXI. XXII.)

The Antelopes are active and elegant animals, which feed on grass, leaves, buds &c. They are most numerous in Africa, but several species inhabit different parts of Europe and Asia.

The Klippspringer (*Oreotragus saltatrix*, Plate XXI. fig. d) is found in the mountains of Southern and Eastern Africa. It feeds on aromatic mountain-herbs, like the chamois, and likewise resembles this animal in leaping with the greatest ease and safety

at a giddy height from rock to rock. In colour it is not unlike the Roebuck. The hair is thick, the body moderately stout, the legs are short and strong, and the hoofs are furnished with claws behind. The buck is ornamented with short straight horns, which rise perpendicularly from the head.

The Chamois (*Rupicapra tragus*, Plate XXII. fig. b) is remarkable for the shape of its horns, which are at first straight, and then curved backwards at the tips. It has some resemblance to a goat in general appearance, but its body is stronger and more compact, and the legs are longer and stronger. It stands about two feet high at the shoulder, and the bucks are rather larger than the does, and have longer horns. In summer the general colour is dull reddish brown above, and rather paler below; and in winter dark brown, with the head, feet and belly white. There is also a dark stripe on each side of the face. Notwithstanding the keenness of their senses, their great shyness and intelligence and their unparalleled agility in leaping and climbing, their numbers are

becoming greatly reduced by the persecution of hunters.

The chamois is met with in most of the high mountains of Southern and Eastern

Europe, where its pursuit can only be attempted by trained mountaineers.

One of the best known antelopes is the Gazelle (*Gazella dorcas*, Plate XXII. fig. c) which the Arabs regard as a

model of natural beauty. The head is adorned with large languishing eyes, and lyre-shaped horns in both sexes. The neck is long and slender, and the rounded body is supported by slender sinewy legs, with very delicate hoofs. The reddish-yellow colouring of the upper surface is separated from the white undersurface by a brownish black stripe running along the sides of the body. The Gazelles are found in large herds in the deserts of Northern Africa and Arabia.

Oxen.

(Plates XXIII. XXIV.)

The Oxen have large heads and bodies, rounded, hollow horns, and a naked, damp muzzle. The tail reaches nearly to the ground and is tufted at the extremity. There are no tear-channels. They are gregarious animals, not very active or graceful in their movements. They feed on all sorts of plants,



Bison or Aurochs.

but chiefly on grass. They are by far the most useful of all ruminants, both living and dead.

The domestic cattle (Plate XXIII. fig. a, b) are spread over the whole world, and there are many varieties. They are believed to be derived from the crossing of at least three originally wild species: *Bos taurus*, *Bos primigenius*, and *Bos longifrons*.

The Zebu (*Bos indicus*, Plate XXIII. fig. d) one of the sacred animals of the Hindus, is remarkable for the large hump above the shoulder, and for the very short flattened horns. It is a quiet, inoffensive animal, but more active than our domestic cattle.

The Musk Ox (*Ovibos moschatus*, Plate XXIII. fig. c) has as much the appearance of a sheep as of an ox. The large broad head has a hairy, narrow muzzle, the body is long, the legs very short, and the tail shorter than in the true oxen. The horns which are curved first downwards and then upwards, are ponderous and dangerous weapons. The Musk Ox inhabits Greenland and the extreme north of North America, and is clothed with long thick brown hair, which is shorter on the legs. It prefers swampy but rocky neighbourhoods, where it feeds in summer on grass and marsh-plants, and in winter on moss and lichens. If it is attacked, it defends itself with great strength and courage.

The Buffalo (*Bubalus vulgaris*, Plate XXIV. fig. a) inhabits Southern Europe, and the adjacent parts of Africa and Asia as far as India. Its body is stout and rounded, the neck short, with no dewlap, and the short, broad head is armed with very large and strongly curving horns. The legs are of moderate length, but very strong, and the tail is rather long. The hair is dark brown, and is rather thin except on the shoulders, the front of the head, and the tuft of the tail. The Buffalo has a formidable and imposing appearance, and is not to be despised as an antagonist, even by the tiger. But the tame buffalo can easily be managed, even by a child, and will yield good milk and excellent meat on very poor food. Both wild and tame buffaloes delight to bathe in swamps and rivers.

The Aurochs (*Bison europæus*) is the largest and fiercest of the European ruminants. Its horns are short, but very strong, and its colour is dark brown. In winter the hair is longer, thicker and darker. The eyes are wild and restless. The Aurochs was formerly common in most parts of Europe, but is now found only in Lithuania (where it is strictly preserved) and in the Caucasus. It is fierce and untamable, but does not generally attack man, though it will give place to no one, especially in winter. A little thing, however, will rouse its fury, when it will charge upon the offending object with red, rolling eyes, and upraised tail. It has been thought that this animal, which stands six feet high at the shoulder, was the Urus which Cæsar saw in the forests of Southern Germany, and which he describes as being nearly as large as an elephant. But it is now believed that Cæsar's Urus was *Bos primigenius*, a very large extinct species, which was one of the ancestral stocks of our domestic cattle. The Aurochs is closely allied to the North American Bison; (generally, but improperly called the Buffalo); and the latter animal, like its European representative, is now nearly extinct in a wild state. The Aurochs is represented on p. 19.

Goats.

(Plates XXIV. XXV.)

Goats are mountain-loving animals. The body is strong and compact rather than elegant in form,

the legs are rather short and strong, the neck short, and the head broad and rather obtuse. Both sexes have strong smooth sickle-shaped horns curved backwards, and a beard under the chin. They climb and leap well; their senses are acute, and their intelligence is considerable.

The Ibex (*Capra Ibex*, Plate XXIV. fig. d) is the wild goat of the Alps. An old buck measures more than four feet long, stands three feet high, and may weigh nearly two hundred pounds. Both sexes have large crescent-shaped horns, curving backwards, bearing strong ridges. The buck is larger than the doe, has a small beard, and his horns attain the length of three feet. The hair is short and reddish grey in summer, but in winter it is paler, longer and thicker. The Ibex surpasses the Chamois in wariness and boldness, but although once common in the Alps, has lately become restricted to a few localities.

The Bezoar Goat (*Hircus Aegagrus*, Plate XXV. fig. a) is very like an Ibex in size, and in the length of the horns, but the horns are differently shaped. They curve backwards in a similar manner, but then turn inwards. The horn has two longitudinal ridges, and the transverse ridges are much wider apart than in the Ibex. They vary much in colour, and the male has a long beard. The usual colour is reddish grey, above, which is separated from the white under-surface by a black lateral streak; there is a dark longitudinal streak on the back, and the neck and breast are black. It inhabits the steep mountains of Western and Central Asia, lives in small flocks, like the Ibex, and is equally difficult to approach.

This species is considered to be one of the principal wild stocks from which the tame Goat (Plate XXIV. fig. b. c) is descended. The Goat is now reared in all countries for the sake of its milk, skin, hair, and flesh. It is fond of the bark of young trees, and is very destructive in plantations.

The Cashmere Goat (*Hircus Laniger*, Plate XXV. fig. b) is reared for the sake of the long silky hair and wool which covers the whole body, except the face and ears, and which is almost as fine and lustrous as silk. It is an animal of moderate size, measuring four feet in length, and standing rather more than two feet high. The colour is variable. It may be yellowish white, brown or black, but the silvery white animals are the most valuable. The Cashmere Goat is reared everywhere in Thibet, Bokhara, &c.

Plate XXV. fig. d) represents the Theban Goat (*Hircus thebaicus*) which is rather smaller than the domesticated goat, but has longer legs and shorter hair, and more resembles a sheep. The head is uglier than in most other goats, for the horns and beard are almost absent, and the back of the nose is so much raised, especially in the buck, that the upper lip is drawn back, and the lower incisors are exposed. This goat is a native of Upper Egypt.

Sheep.

(Plate XXV. XXVI.)

The Sheep are distinguished from the Goats by their ridged, three-sided, and generally spiral horns, the large tear-channels, the glands between the hoofs, and the absence of a beard. The head is much narrowed in front, the body slender, and thickly clothed with hair or wool, the legs are long and slender, and the tail is short, or moderately long. Wild sheep inhabit the mountain regions of the

Northern Hemisphere, and tame sheep are reared in all parts of the world.

The Argali (*Caprovis Argali*, Plate XXV. fig. c) is a very large and powerful wild sheep inhabiting the mountains of Siberia. It measures six feet in length, and nearly four feet in height. The horns of the ram are three or four feet long, and weigh fifty pounds; they are first curved downwards, and then upwards; those of the ewe are much shorter and lighter, and nearly straight. The long thick fleece is greyish brown in summer, and reddish brown in winter, but the snout, the thighs and the tail are always white. The Argali lives in flocks of eleven or twelve individuals, and always remains in the same district; it is very wary, and if alarmed, escapes with prodigious bounds from rock to rock.

The Mouflon (*Ovis musimon*, Plate XXVI. fig. a) is much smaller than the Argali, but is nevertheless of considerable size, measuring four feet in length, including the tail, and standing two feet and a half high. The horns, too, which are usually met with

only in the ram, are smaller and lighter than in the Argali, and never exceed two feet and a half in length. The hair is short and thick, the colour is reddish tawny, with a dark stripe on the back, and the undersurface is white. The Mouflon lives in flocks of forty or fifty individuals under the leadership of a strong ram, and is still found in considerable numbers in the rocky mountains of Corsica and Sardinia.

The common Sheep (*Ovis aries*, Plate XXVI. fig. b. c) has long curly wool, a long tail, and short horns, only present in the ram. The wild sheep is active, lively, and possessed of a certain amount of intelligence, but the tame sheep is a sluggish creature, quite incapable of self-defence, and ready to rush headlong into any danger, unless restrained and protected by the shepherd and his faithful dog. The value of the fleece, the skin, and the flesh of the sheep is great; and the wool is particularly fine and soft in the Merino (Plate XXVI. fig. d) a moderate-sized, robust animal, with a large head, a convex snout, and large horns in the ram.

Order XII. Sirenia. (Manatees and Dugongs.)

(Plate XXVIII.)

The *Sirenia* are aquatic animals with fish-like bodies like the whales. They resemble them also in the form of the head, which is always furnished with molar teeth at least; the mobility of the seven cervical vertebræ; and the structure of the limbs. The front limbs are covered with hide and converted into fins, and the hind limbs and tail are united to form a rudder.

The *Sirenia* are sluggish animals, which feed on water-plants, and rarely venture on land, where they are almost helpless. They are found in bays, estuaries and large lakes, through which rivers flow. There are but two families, *Halicornidae* and *Manatidae*, each containing a single existing species.

The Dugong (*Halicornia Dugong*) inhabits the shores of the Indian Ocean, and attains a length of from nine to fifteen feet. The short thick neck is distinctly separated from the head, but passes immediately into the body, which is rotund, and

gradually increases in thickness from the neck to the middle, beyond which it narrows again. The tail-fin forms a somewhat crescent-shaped flapper. The long truncated upper lip forms a movable snout. The senses are not very acute, and the animal's food consists entirely of seaweed.

The genus *Manatus* has a perpendicular, rounded tail-fin. These animals have a fishlike body, thinly clothed with hair, and when full-grown, they only possess molar teeth.

The Sea-Cow or Manatee (*Manatus australis*, Plate XXVIII. fig. e) attains a length of nine feet, and a weight of 600 or 700 lbs., and

possesses a movable snout-like upper lip. It inhabits the coasts and bays of the Atlantic Ocean, especially in the West Indies, and on the Northern coast of South America. Although associated with seals and icebergs on our plate, it would be a mistake to imagine that it has any connection with either. It is much hunted for the sake of its hide and flesh.



Dugong.

Order XIII. Cetacea. (Whales and Dolphins.)

(Plates XXIX. XXX.)

The Whales are exclusively marine animals, and some of them attain to an immense size and bulk. The large flattened head is not separated from the body by a narrower neck; the jaws are enormous, the eyes are very small, and there are no external ears over the small auditory openings. The body is long, stout and fishlike, and terminates in a horizontal fin, in which no trace of hind limbs or tail is visible.

Mammalia.

The whole body is covered with a thick layer of fat, or "blubber", which renders these animals valuable. All the Whales swim well and with great rapidity, but as they breathe with lungs, they are obliged to come to the surface at intervals.

The *Baleenidae*, or Whalebone Whales have no teeth in their jaws, but there is a channel on each side in the gums, which is filled with perpendicular

layers of a horny substance, which form a kind of sieve to collect the small marine animals on which these Whales feed. The head is enormous, the throat very narrow, and the tongue immovably fixed in the mouth. Whales are generally met with singly, or in small shoals, and are most abundant in the Arctic Ocean.

The Right Whale, or Greenland Whale (*Balaena mysticetus*, Plate XXIX. fig. a) grows to the length of about sixty feet, of which the head occupies one-third. The nostrils, which are called "blow-holes", are situated on the top of the head, the eyes are very small, and the openings of the ears hardly visible. The immense jaws are furnished with from 310 to 350 layers of whalebone on each side. This and the blubber make a large whale worth about £ 750.

The Cachalot or Sperm Whale (*Physeter macrocephalus*, Plate XXIX. fig. b) the type of the family *Physeteridae*, is intermediate between the true Whales and the Dolphins. It resembles the former in its large size, and the latter in the possession of conical teeth, which are considerably larger in the lower than in the upper jaw. The head forms one-third of the total length. The blow-holes are situated in front of the nearly vertical snout. The body is of equal breadth to beyond the middle, and then grows narrower, terminating in a deeply excavated tail-fin. The Cachalot is found in many seas, but is commonest in the Antarctic Ocean.

The Narwhal (*Monodon monoceros*, Plate XXX.

fig. a) which is generally included with the true Dolphins in the family *Delphinidae*, is a swift and active animal, remarkable for a long spiral tusk on the left side of the upper jaw of the male, which is about nine feet long, and as hard as ivory. The right tusk is rarely developed, and the tusk or tusks are generally, but not always, rudimentary in the female. The male grows to the length of about fifteen feet, but the female is smaller. The head is small, the neck short and thick, the body spindle-shaped, and the tail-fin very large.

The Dolphins are small or moderate sized whales with small and often long and pointed heads, numerous teeth, uniform in size and shape, in both jaws, and a moderately stout body with small fins on the back and at the tail. They swim and dive very well, live in shoals, and actively pursue the marine creatures on which they feed. They are found in the seas of all parts of the world, but sometimes swim up into rivers and lakes.

The Common Dolphin (*Delphinus delphis*, Plate XXX. fig. b) measures about seven or eight feet in length. This species sometimes plays about a ship in shoals of from six to ten individuals, for hours together, and amuses the sailors by its agile movements in pursuit of the flying fish. Although it looks so harmless, it is really one of the most predacious of marine animals. It has curved and pointed fins on the back and sides, and a crescent-shaped tail-fin. The colour is dark grey above and lighter below.

Order XIV. Edentata. (Sloths, Anteaters, Armadilloes &c.)

(Plate XV.)

The Edentata, or Toothless Animals, derive their name from the very imperfect development of the teeth, which are either wholly or in great part absent. Their claws, however, which they employ either for climbing, or for scraping and digging, are very large. All the animals which belong to this Order are inhabitants of warm countries.

In the Sloths, or *Bradypodidae*, the head is short and rounded, without external ears, and with lustreless eyes; the neck is long, the body stout, without a tail, and covered with long hair, which looks like hay. The front legs are longer than the hind ones, and the toes are armed with long sickle-shaped claws. The Sloths are very sluggish animals on the ground, but they are more active among the branches of the trees. They are found in the thick primeval forests of South America, especially Brazil.

The Three-toed Sloth (*Bradypus tridactylus*, Plate XV. fig. c) measures about three feet in length when full grown. The front claws are six inches long, and the hind ones a little shorter. With these the animal can cling so tightly to a branch that three men can hardly drag it away. The hide is ashy grey or greyish brown, and there is a broad brownish streak on each side of the back, running to the extremity of the body.

The Armadilloes (*Dasypodidae*) are stout animals, with long heads, rather large upright ears, a long and thick tail, and short legs, armed with strong claws for burrowing. But they are most remarkable for the coat of armour which covers the upper surface of the body, and the tail. They are nocturnal animals, which sleep in their holes by day, and come

forth at the approach of darkness to feed on all sorts of insects. They inhabit South America.

The Bristly Armadillo (*Dasypus setosus*, Plate XV. fig. d) has six and often seven movable rows of plates on the middle of the back. The parts of the creature's body that are not clothed with armour, are clothed by a wrinkled skin, covered with many flat warts. Behind the neck, and behind the belts of armour, as well as behind each separate row of plates on the back, and behind the plates on the tail are several stiff bristles. The animal is two feet long and a foot high.

The *Myrmecophagidae*, or Anteaters have a long body supported by short strong legs. There are from two to four toes on the fore feet, and four or five on the hind feet, which are furnished with strong claws, which the animal employs to turn up the ground. The head is long, the tail cylindrical the mouth very small, and the tongue long and extensile, like that of a woodpecker. The tail is long or short, smooth or bushy. The Anteaters inhabit the woods and plains of South and Central Africa and of a large part of South America.

The Great Ant-eater (*Myrmecophaga jubata*, Plate XV. fig. a) is rather abundantly clothed with hair; a mane runs along the back, and the tail is bushy. The head is a long pointed cone, the eyes and ears are small, and the mouth is a small cleft. The tongue is three inches broad, and sticky, and can be stretched out of the mouth for a distance of more than a foot. There are four toes on the fore legs, armed with strong curved claws, and there are five toes on the hind legs, armed with weaker and straighter claws. The fullgrown animal measures nearly five feet to the root of the tail, and the tail,

including the hair, is three feet long. It is very useful in South America, where it roots up the nests and galleries of ants and termites, and then devours the insects.

In the *Manidae* the whole body except the throat, the belly, and the inside of the legs, is clothed with large flat horny scales, which overlap each other like the scales of a fir-cone. The body and tail are long, and the legs short, and armed with strong claws. The head is small, the snout conical, the jaws toothless, and the tongue rather long and ex-

tensible. These animals, which are useful, like the Ant-eaters, by destroying the nests of ants and termites, inhabit the woods and forests of Central Africa and Southern Asia.

Temminck's Scaly Anteater (*Manis Temminckii*, Plate XV. fig. c) is a native of Southern Africa. The head is short and thick, the body oval and the tail, which is as long as the body, is suddenly truncated at the tip. The large scales are pale yellowish brown, and paler at the extremity. A full-grown male measures about four feet in length.

Order XV. Marsupialia. (Pouched Animals.)

(Plate XII.)

The *Marsupialia* or Pouched Animals differ very much in form; some resemble dogs and martens; some are more like hares and other Rodents, while others, again, resemble Shrew-Mice. Their habits are equally various. Some feed on small animals, and others on vegetable matters only. Some are nocturnal animals, and extremely sensitive to light, while others only roam abroad by day. They are distinguished from other animals by the female possessing a pouch on the belly, in which the helpless young are carried for some time after birth.

We have given illustrations of three of the families included in this Order.

The *Didelphidae*, or Opossums include various species, distributed over America. Here they live in woods and thickets, coming forth at night to feed on small animals and birds, as their large canine teeth would indicate.

The Opossum (*Didelphys virginiana*, Plate XII. fig. c) is about as large as a cat. The body is rather stout, the neck is short and thick, and the long head gradually narrows to a pointed snout. The great toe of the hind feet can be opposed to the others; and the naked tail serves as an organ of prehension. The Opossum gives birth to its young after 14 days, when it places them in the pouch, where it suckles them for thirty days, when they are pretty well developed, but they still remain in the pouch for some time, and only leave it occasionally.

The *Phalangistidae* have a hairy web between the limbs, which serves them as a parachute.

The Taguan (*Petaurista taguanoides*) is a native of Australia. It has a small head and short tail, very large eyes and broad and very hairy ears. The feet are armed with strong curved claws. The fur is long and soft, and the tail is bushy. The colour varies considerably.

The upper surface is generally brownish-black, the parachute sprinkled with whitish, the undersurface white, the muzzle, chin and paws black. This animal sleeps by day in hollow trees, and seeks its food, which consists of leaves and the young shoots of trees, only at night.

The *Macropodidae* or Kangaroos have the hinder part of the body, as well as the hind limbs and tail, greatly developed, while the head, neck, chest and fore limbs are comparatively small and weak. These animals are found in Australia, and generally frequent grassy or bushy places, but a few species inhabit rocky districts, and others may be met with in trees. Only some

of the smaller species are nocturnal in their habits. The larger ones feed on grass and leaves during the day, and if disturbed, endeavour to escape by making prodigious leaps with the aid of their hind legs and tail. As they eat the grass which is required for the sheep, the colonists hunt them down, and they are now much less abundant than formerly.

The Kangaroo (*Macropus major*, Plate XII. fig. d) is the largest of the family. An old male in a sitting posture is nearly as tall as a man, and measures, including the tail, above seven feet in length. It is hunted for its soft fine fur and delicate flesh, and is now disappearing from the more settled parts of Australia, though still common in the interior.



Taguan.

Order XVI. Monotremata. (Duck-Bill and Spiny Anteater.)

(Plate XV.)

In this Order, the muzzle is prolonged into a kind of beak, without fleshy lips or bony teeth. They resemble birds and reptiles in having a dry covering for the jaws, a cloaca (or common opening

for the urine and excrements) and two mandibles. They also resemble Marsupials in possessing marsupial bones, and a pouch on the belly, which is sometimes conspicuous. But the most remarkable thing about these animals is that they lay eggs with parchment-like shells, similar to those of reptiles, and incubate them in the pouch on the belly. There are only two or

three species of these very curious animals, which inhabit Australia and New Guinea.

The Duck-Bill (*Ornithorhynchus paradoxus*, Plate XV. fig. b) is a foot and a half in length, including the tail. It has a flattened, beaver-like body, with thick brown fur. The legs are short,

and there are five strongly webbed toes on each foot. The tail is broad and smooth. The small head is furnished with a broad toothless beak like that of a duck, and the tongue has a projection behind which

converts the whole cavity of the mouth into a closed weir. This curious animal is found in Australia, especially in the eastern parts, where it digs itself long burrows in the banks of rivers and ponds, and swims about in muddy places in search of the insects on which it feeds.

The Spiny Anteater (*Echidna hystrix*) has spines like a hedgehog, a

very small opening for a mouth, like an anteater, and a worm-like tongue. It lives in lilly districts, and seeks for its prey by night. It feeds chiefly on ants, which it seizes with its tongue. When alarmed it rolls itself into a ball, like a hedgehog.



Spiny Ant-eater.

Anthropoid Apes.

I.



a) Chimpanzee.
Troglodytes niger.

b) Orang-utan.
Simia Satyrus.

c) White-handed Gibbon.
Hylobates Lar.

d) Siamang.
Hylobates syndactylus

Monkeys and Baboons.

II.



a) Capuchin Monkey.
Cebus Apella.

b) Green Monkey.
Cercopithecus sabaenus.

c) Baboon.
Cynocephalus Babuin.

d) Mandrill.
Papio Maimon.

e) Black Howler.
Mycetes niger.

f) Barbary Ape.
Inuus ecaudatus.



a) Red Howler.
Myeetes seniculus.

b) Capuchin Monkey.
Cebus capucinus.

c) Squirrel Monkey.
Callithrix sciurea.

d) Lion Tamarin.
Midas rosalia

e) Maki.
Lemur Macaco



Flying Lemurs and Bats.

IV.



a) Great Kalong.
Pteropus edulis.

b) Vampire Bat.
Vampyrus spectrum.

c) Noctule.
Vesperugo noctula.

d) Long-eared Bat.
Plecotus auritus.

e) Great Horse-Shoe Bat.
Rhinolophus ferrum-equinum.

f) Flying Lemur.
Galeopithecus volans



a) Genette.
Genetta vulgaris.

b) Swamp Ichneumon.
Ichneumon galera

c) Mongoose.
Herpestes javanicus.

d) Pine Marten.
Mustela martes.

e) Beech Marten.
Mustela foina

f) Polecat.
Putorius foetidus



a) Weasel <i>Mustela putorius</i>	b) Stoat. <i>Mustela erminea.</i>	c) Ferret. <i>Putorius furo.</i>	d) Sable. <i>Martes zibellina.</i>	e) Skunk. <i>Mephitis Chinga.</i>	f) Otter. <i>Lutra vulgaris.</i>	g) Sea Otter. <i>Erethra lutris</i>
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a) Lion.
Felis leo

b) Lioness.
Felis leo

c) Tiger.
Felis tigris

d) Jaguar.
Felis onca



a) Leopard.
Felis pardus.

b) Puma.
Felis concolor.

c) Lynx.
Felis lynx.

d) Wild Cat.
Felis catus.

e) Cat.
Felis domestica.





a) Striped Hyaena.
Hyaena striata.

b) Spotted Hyaena.
Crocuta maculata.

c) Greyhound.
Canis domesticus, var.

d) Pointer.
Canis domesticus, var.

e) Wolf.
Canis lupus.



a) Jackal.
Canis aureus.

b) Fox.
Vulpes vulpes.

c) Hedgehog.
Erinaceus europaeus.

d) Shrew-mouse.
Sorex vulgaris.

e) Water Shrew.
Glossopus fodiens.

f) Tuscan Shrew-mouse.
Pachyura trusca.

g) Mole.
Talpa europaea.



a) Black Bear.
Ursus americanus.

b) Brown Bear.
Ursus arctos

c) Polar Bear.
Ursus maritimus.

d) Raccoon.
Procyon lotor



a) Glutton.
Gulo luscus

b) Badger.
Meles vulgaris

c) Opossum.
Didelphys virginiana

d) Kangaroo.
Macropus major

e) Porcupine.
Hystrix cristata

f) Guinea Pig.
Cavia cobaya



a) Agouti.
Dasyprocta aguti

b) Hamster.
Cricetus crinitus

c) Marmot.
Arctomys marmota

d) Squirrel.
Sciurus vulgaris

e) Lemur.
Gloria vulgaris

f) Short-tailed Field Mouse.
Arvicola arvalis

g) Mouse.
Mus musculus

h) Brown Rat.
Mus decumanus

i) Long-tailed Field-Mouse.
Alus sylvaticus

k) Mole Rat.
Spalax typhlus



a) Hare.
Lepus timidus

b) Alpine Hare.
Lepus variabilis.

c) Rabbit.
Lepus cuniculus.

d) Beaver.
Castor fiber.

e) Musquash.
Fiber Zibethicus.



a) Great Ant-eater.
Myrmecophaga jubata.

b) Duck-Bill.
Ornithorhynchus paradoxus.

c) Scaly Ant-eater.
Manis Temminckii.

d) Bristly Armadillo.
Dasypus setosus.

e) Three-toed Sloth.
Bradypus tridactylus.



a) Indian Elephant.
Elephas indicus.

b) One-horned Rhinoceros
Rhinoceros indicus.



a) American Tapir.
Tapirus americanus.

b) Hippopotamus.
Hippopotamus amphibius.

c) Pig.
Sus scrofa.

d) Wild Boar.
Sus scrofa.



a) Camel.
Camelus dromedarius.

b) Bactrian Camel.
Camelus Bactrianus.



a) Llama.
Auchenia Llama.

b) Musk Deer.
Moschus moschiferus

c) Elk.
Alces Malchis.



a) Reindeer.
Tarandus rangifer.

b) Stag.
Cervus elaphus





a) Fallow Deer.
Dama vulgaris

b) c) Roe Deer.
Capreolus caprea

d) Klippspringer.
Oreotragus saltatrix



a) Giraffe.
Camelopardalis Giraffa.

b) Chamois.
Rupicapra tragus.

c) Gazelle.
Gazella dorcas



1. Bull and Cow.
Long Horns.

2. White Ox.
Common.

3. Zebu
Common.



a) Buffalo.
Bubalus vulgaris.

b) c) Goat.
Hircus aegagrus, var.

d) Ibex.
Capra Ibex



a) Bezoar Goat.
Hircus aegagrus.

b) Cashmere Goat.
Hircus aegagrus, var.

c) Argali.
Caprovus argali.

d) Theban Goat.
Hircus thebaicus.



a) Mouflon.
Ovis montanus

b) c) Sheep.
Ovis aries

d) Merino Sheep.
Ovis aries, var.



a) Arabian Horse.
Equus caballus.

b) Ass.
Equus asinus

c) Zebra.
Equus Zebra

d) Quagga
Equus quagga





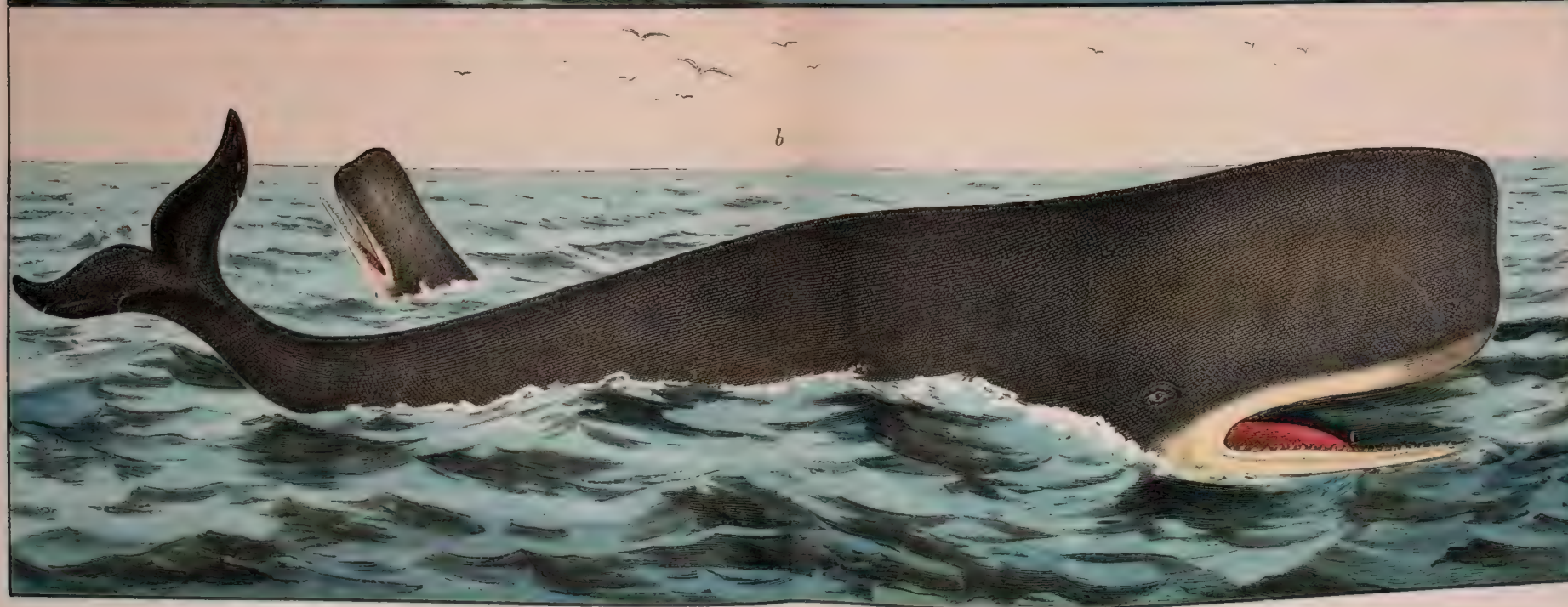
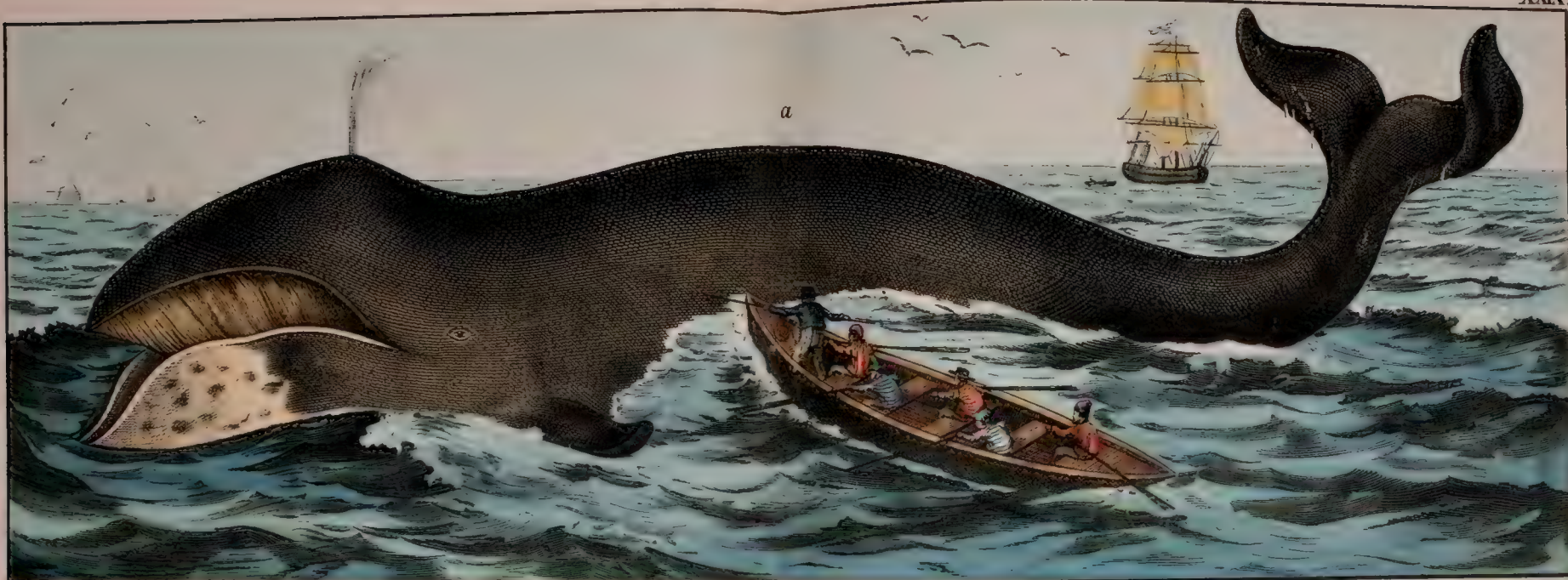
a) Common Seal.
Phoca vitulina

b) Sea Bear.
Otaria ursina.

c) Sea Lion.
Otaria jubata.

d) Walrus.
Trichechus rosmarus

e) Manatee.
Manatus australis



a) Right Whale.
Balaena mysticetus

b) Cachalot.
Physeter macrocephalus



a) Narwhal.
Monodon monoceros

b) Dolphin.
Delphinus delphis

INTRODUCTION.

THE BIRDS constitute the Second Class of Vertebrate Animals. They resemble Mammalia in having warm red blood, and a complete system of circulation, for their heart, like that of Mammalia, contains four chambers, two auricles and two ventricles. But instead of bringing forth living young, birds lay eggs, which they hatch in more or less neatly constructed nests. The number of cervical vertebræ is not limited to seven, as is almost invariably the case in Mammals, but increases in proportion to the length of the neck. But the most immediately obvious characteristics of birds are the conversion of the front limbs into organs of flight, and the feathery covering of the whole body, which replaces the hairy coating of mammals.

These feathers are gradually thrown off, and are replaced by new ones, at least once a year. This generally takes place in autumn, and is called moulting.

A fully developed feather consists of the quill, the shaft and the vane. The vane consists of many thin layers, called barbs, which are linked together by fine hooked processes. The feathers are not found upon all portions of the skin, but on definite spaces, which are called Pterylæ or feather-tracts. The head is usually covered with feathers. One feather-tract extends on the lower side of the neck to the breast. There the feather-tracts fork. A similar feather-tract commences behind the head, and extends over the whole back to the tail. The feathers are so arranged, that, although placed on definite tracts, they form a protective covering to the whole body.

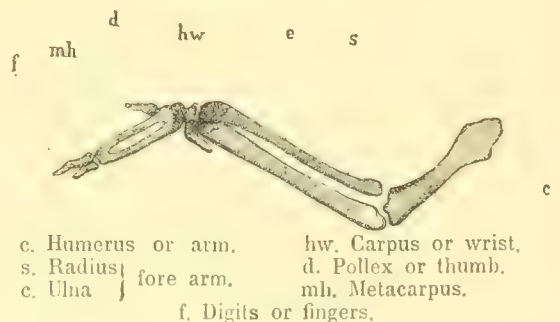


Skeleton of Bearded Vulture

The bare or downy spaces (Apteria), are very serviceable to the bird, for they enable it to move its head and neck in all directions, and to cover its head when it sleeps.

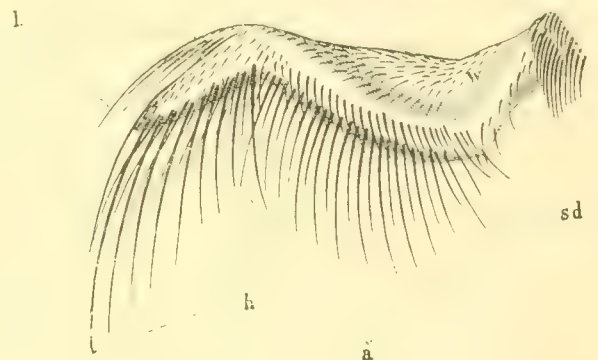
The wings, or fore limbs of birds are constructed on the same model as the fore limbs of mammals. They consist of arm, forearm, and hand. The wings are furnished with a series of long and strong feathers (quills), which serve for flight. The hand is composed of a thumb and two fingers only, and the thumb with its clothing of feathers is called the Alula or bastard-wing. The direction in flight is chiefly guided by the tail-feathers.

Wing-bones of Bird.



- | | |
|-----------------------|----------------------|
| c. Humerus or arm. | hw. Carpus or wrist. |
| s. Radius fore arm. | d. Pollex or thumb. |
| ul. Ulna | mh. Metacarpus. |
| f. Digits or fingers. | |

Arrangement of Wing-feathers.



- | | |
|------------------|--------------------------|
| h. Primaries. | sd. Scapulars. |
| a. Secondaries. | l. Alula or Bastard-Wing |
| w. Wing-coverts. | |

On examining the legs, we find that the femur and the tibio-fibula are clothed partly with flesh, and partly with feathers. The slender tarso-metatarsus is covered with horny scales, and terminates

in four toes with curved claws. Three toes are usually directed forwards, and one backwards.

Life is motion, and this is particularly the case with birds, which never rest, except when sleeping. Birds can run, hop, climb and swim, but their most characteristic movement is flight. Many birds are remarkable for not remaining always in the same locality. These are called birds of passage. Some visit warmer regions during winter, while others are only seen in our climate during the cold part of the year. Birds are driven to migrate through scarcity of food, and different species feed on different animal and vegetable substances.

The senses of sight, hearing and smell are exceedingly acute in most birds. Their senses of touch and taste are less remarkable, and are only well-developed in certain groups. But their perception of locality is most wonderful, for it enables them to find their way across sea and land to their breeding-places.

The construction of their nests, the ease with which they accustom themselves to the presence of man, and their behaviour in captivity, exhibits an amount of intelligence only surpassed by that which we find among the highest mammals. Birds are found in all countries, and their feathery covering is especially adapted to their habits and surroundings.

There are about 12,000 species of birds at present known. The Orders of Wading and Swimming Birds are the most numerous.

Birds may be divided into two great groups. In the first group, or Insectores, the young birds remain helpless in the nest for some time after they are hatched, and are fed by the parents. In the second group (*Autophagi*) the young birds leave the nest soon after they are hatched, and seek their own food under the guidance of the parent birds. The Insectores excel in flying and the *Autophagi* in running or swimming.

Birds are divided into seven Orders, according to the structure of the beak and toes.

Sketch of Orders of Birds.

A. Insectores.

- Order I. *Accipitres* (Birds of Prey). Beak curved. The upper mandible is clothed with a wax-like skin or cere at the base, and curves over the lower mandible at the tip. The claws form curving hooks.
- „ II. *Scansores* (Climbing Birds). Beak except in the parrots without cere. Feet with sharp claws and adapted for climbing.
- „ III. *Syndactylæ* (Hornbills and Kingfishers). Beak ridged and very long. Feet fitted for walking.
- „ IV. *Passeres* (Singing Birds). Beak tube-like or conical. Feet with sharp claws and fitted for walking or hopping.
- „ V. *Columbæ* (Pigeons). Beak straight. Nostrils surrounded by a soft skin. Toes divided to the base.

B. Autophagi.

- „ VI. *Gallinæ* (Poultry and Game-Birds). Upper mandible of the beak overlapping the lower one at the tip and sides. Four toes, the three front ones slightly connected at the base and the hind toe placed rather higher than the others.
- „ VII. *Cursores* (Running Birds). Wings short, unfitted for flying. Legs long and strong and adapted for running.
- „ VIII. *Grallatores* (Wading Birds). Legs very long. Toes webbed.
- „ IX. *Palmipedes* (Swimming Birds). Toes webbed or provided with membranous appendages.

A. INSESSORES.

Order I. Accipitres. (Birds of Prey.)

The Birds of Prey have great powers of flight, and their senses are likewise highly developed. Though not brightly coloured, they are powerful and handsome birds, and have always attracted much interest. They feed on the flesh of vertebrate animals which they capture and kill, but some will also devour carrion, and a few of the smaller species will eat insects. The head is large and rounded, and the upper mandible of the beak is covered with a wax-like membrane, or cere, at the base, and is strongly hooked at the tip. The body is robust, the wings long and pointed, the legs strong, and the toes armed with sharp curving claws. They generally live in pairs, and some species pursue their prey by day, and others only at night.

Family I. *Vulturidæ* (Vultures.) (Plate I.)

In the Vultures, the beak is only curved at the tip, the head and neck are bare, or only covered with a short down, and the feet are armed with strong, but rather blunt claws. They inhabit warm countries, where they are very useful in devouring carrion. Their senses are acute, and the birds fly well, except when gorged.

Fig. a. The Egyptian Vulture (*Neophron percnopterus*) is one of the best-known representatives of the group. Its dirty white and always untidy plumage, its naked, saffron-yellow head, and its filthy odour render it peculiarly disgusting.

Fig. b. The Griffin Vulture (*Gyps fulvus*) is reddish-brown, with black wings and tail; the short down on the head and neck is light grey. It is a large bird, the male measuring nine feet in expanse of wing, and the female, which as in most birds of prey is larger, somewhat more. Like the last species, it is found in the greater part of Africa, Southern Asia, and Southern Europe.

Fig. c. The Condor (*Sarcorhamphus gryphus*) is found in the Andes of South America and is the largest of all living birds of prey, measuring when full-grown twelve feet in expanse of wing. This bird flies at a vast height; travellers have seen it flying above the lofty peaks of the Cordilleras, and then suddenly swooping down with amazing rapidity. It is not a very handsome bird. The head and a portion of the neck are entirely bare. There are curious folds of skin above the beak and on the throat, and there is a peculiar greyish-white downy ruff on the lower part of the neck.

Family II. *Falconidæ*. (Eagles, Falcons and Hawks.) (Plate I.)

The Eagles and Falcons are the noblest of the Birds of Prey. Their head and neck are covered with feathers, their beak is curved from the base, and the upper mandible is notched; the wings are long and pointed, and the claws extremely sharp. They feed exclusively on freshly-killed, and preferably on warm-blooded prey. The Eagle is often ranked as the

King of Birds, as the Lion is called the King of Beasts. The Eagles have a crest of pointed feathers on their head, and their strong arching beak is curved downwards from the middle.

Fig. d. The Bearded Vulture or Lammergeyer (*Gypaëtus barbatus*) resembles the eagles in its feathered head and neck, and in its preference for living prey, while it is more like the vultures in the shape of the beak, and in the shortness of its talons. The belly is orange-coloured, and the back and wings are brown, with white blotches, and the beard of bristly feathers at the base of the lower mandible is black. It is the largest bird of prey which inhabits the temperate zones, for its wings expand over nine feet; and thus it is not much inferior to the Condor in size. It inhabits the mountains of Southern Europe as far as the Alps, and is likewise found in the Himalayas. It is very destructive to small or weakly animals, and is said sometimes to attack children.

Fig. e. The Secretary Bird (*Serpentarius secretarius*) inhabits the dry sandy regions of Africa, and feeds on snakes and other vermin, which it destroys with the aid of its strong scaly legs. The feathered neck, and black crest on the back of the neck, and the long legs give it so remarkable an appearance that it could not be confounded with any other bird of prey.

(Plate II.)

Fig. a. The Golden Eagle (*Aquila chrysaetos*) inhabits mountainous districts in Europe, Asia and North America, where it builds its nests either among precipitous rocks, or on old and lofty trees. It generally rears only two young ones, and cannot therefore increase very rapidly. It feeds on animals



Egg of Golden Eagle.

from the size of the roebuck and the swan down to marmots and partridges. Its plumage is reddish yellow, varied with dark brown, and when full grown it measures nearly three feet in length, and its wings expand seven feet.

Fig. b. The White-tailed Eagle (*Haliaëtus albicilla*) has the basal portion of the tarsus feathered. It may be recognised afar off by its dark-brown plumage, shading into yellowish white on the head

and neck, and its white tail. This species occurs throughout the greater part of Europe and Asia, and is very destructive to lambs and other small animals.

The Harpy Eagle (*Thrasactus destructor*) is the finest of the eagles which inhabit Central and South America. The body is very robust, the head large, and the legs thicker than in any other birds of prey. The head and neck are grey, the back, the wings, the upper part of the breast, and the tail are black; the lower part of the breast is white. This bird is remarkable for continuing to moult throughout the whole year. The Harpy Eagle is a most formidable enemy to the Howling Monkeys, deer, and even children. It also feeds on sloths, and tears them away in fragments from the branches to which they cling.

Fig. c. The Serpent Eagle (*Circaetus gallicus*) feeds chiefly on *Amphibia*, but will also eat snails and worms. The beak is clothed with a wax-like cere, the feet are blue, the back brown, the belly white, with light brown spots, and the tail marked with three dark transverse bands. It inhabits Southern Europe, Western Asia, and North Africa.

The Kites (*Milvus*) are slender birds, of moderate size. Their beak is much curved towards the tip, and ends in a strong hook. The short toes are armed with claws which are only slightly curved and the wings are long and pointed. But their most remarkable character is the long forked tail.

Fig. d. The Kite (*Milvus rufus*) is of a prevailing rusty-red colour, the beak bluish, and the cere and feet yellow. It is found throughout Europe, as well as in Northern Asia and Africa, and is rendered conspicuous by its deeply-forked tail, and by its sailing, though not rapid flight. In England it is now very scarce. It feeds on small mammals, birds, snakes, toads, insects, &c., as well as on refuse of all kinds.

(Plate III.)

The Harriers (*Circus*) have long narrow wings, adapted for very rapid flight, and speed backwards and forwards in the evening twilight at a moderate elevation over level ground, and pounce upon mice and other small animals and birds. They build their nests on the ground. The beak is small, the legs have long slender shanks with rather short toes, and but slightly curved claws.

Fig. a. One of the best known species is Montagu's Harrier (*Circus pygargus*). The adult male is brownish grey on the head, neck and back; the belly and the upper tail-coverts are white. The adult female is similarly coloured, but the feathers are rather less varied with grey. This bird inhabits

Southern and Central Europe, and is more mischievous than beneficial, for it destroys many useful little birds.

The Buzzards (*Buteo*) on the other hand are to be regarded as useful birds, for they feed principally on field-mice, hamsters, &c., and will also eat insects. They frequent mountains and plains, but prefer small woods surrounded with fields. Their flight is slow, sailing, and long-sustained, and they dart down in a slanting direction when they perceive their prey. Their beak is small, weak, and not dentated, their legs and toes are short, and their claws of moderate size.

Fig. b. The Common Buzzard (*Buteo vulgaris*) is a voracious bird, and destroys great numbers of mice and similar vermin, though it does not despise a hare, a partridge, or a singing bird occasionally. The prevailing colour is a paler or darker brownish grey, the breast is white, with long pale streaks, the cere and feet are yellow, and the claws, which are rather long and sharp, are black. It is found throughout the temperate parts of the Northern Hemisphere.

In the Ospreys or Fish-hawks, the body is comparatively small, but strongly made, the head is of moderate size, the wings broad and long, the beak strong, terminating in a long hook, and the large feet are armed with strong toes, which are rough and rasplike beneath, and are armed with very long and sharp claws.

Fig. c) represents the Osprey (*Pandion Haliaeetus*). The beak is black, the cere and feet are light blue, the crown of the head, and the undersurface of the body white, with scattered brown spots; and the back and the tail brown, the latter with six broad brown transverse stripes. A broad brown stripe runs down from the eyes to the sides of the neck. It roosts on high trees in the neighbourhood of rivers, and

preys upon fish. It is common in many countries of both hemispheres.

The Goshawks (*Astur*) may be known by their strong and distinctly toothed beak, which is curved from the base, the comparatively long legs with long toes and sharp

claws, and the short, but rather pointed wings.

Fig. c. The Goshawk (*Astur palumbarius*) is a formidable enemy to poultry-yards. It is a bold marauder in woods and fields, and as it does not despise small birds, it creates a panic among them



Harpy Eagle (*Thrasactus destructor*)



Egg of Osprey.

wherever it appears. It is found throughout the greater part of the Northern Hemisphere.

The true Falcons, formerly so much prized for the sport called Falconry, are much bolder and swifter birds, with far greater powers of endurance. The short strong beak is provided with one sharp tooth, and the legs are short, with very long toes, and curved, sharply-ridged claws; the wings are long and narrow. Their food consists of birds, which their rushing flight enables them to seize upon the wing, and they are consequently among the most destructive birds of prey. They fly most in the morning and evening. They build their nests in crevices among steep rocks, or on the summits of the loftiest forest-trees.

Fig. d. In the Jerfalcon (*Hierofalco candicans*) the prevailing colour is white, with darker longitudinal and transverse markings. It inhabits the extreme north of Europe, Asia and America, and makes its nests among steep rocks, especially near the sea.

Plate IV.

Fig. a. The Peregrine Falcon (*Falco peregrinus*) is much more widely distributed than the Jerfalcon, and is found in nearly all parts of the world, either as a resident, or as a casual visitor.

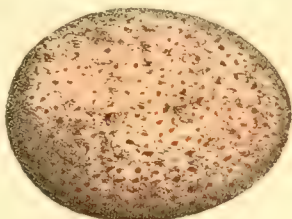
Fig. b. The Hobby (*Falco subbuteo*) is one of the swiftest of the birds of prey. It feeds on small birds, especially larks. The adult male is dark brown above and white beneath, with blackish longitudinal streaks; on the cheeks is a sharply-defined black streak. It is common in most parts of Europe and the adjacent countries.



Egg of Hobby.

The Kestrels are distinguished from the true Falcons by their shorter toes and softer feathers.

Fig. c. The Kestrel (*Falco tinnunculus*) is ashy grey on the head and tail in the adult male, and the back and wings are cinnamon-colour with black lanceolate spots, the throat is white, and the rest of the undersurface of the body reddish yellow. It is common in many parts of the Old World, migrating towards the south in winter. It feeds on mice, small birds and insects.



Egg of Kestrel.

Fig. d. Our figure of the Sparrow Hawk (*Accipiter Nisus*) is taken from an old male; the female is larger, and of a lighter colour. It is exceedingly daring in its pursuit of the sparrows and other small birds on which it feeds. It is common throughout the greater part of Europe and Asia.

Fig. e. The Chanting Falcon (*Melierax muscus*) is distinguished from the hawks by its more slender form, weaker beak, and longer and stronger legs, with shorter toes and claws. It is a sluggish bird, which feeds on insects and other small game. This bird is noted for its power of singing, an uncommon accomplishment among birds of prey,

whose usual voice is a harsh scream; but its capacities as a songster appear to have been much exaggerated. It is a native of South Africa.

Family III. Strigidae. (Owls.)

(Plate V.)

The Owls have soft and very flossy plumage, which makes them look much larger than they really are. They have a large round head, a short sharp-pointed beak, very large eyes, surrounded with a ruff of feathers, wide ears, closing by a flap, short, feathered legs, and strong and very sharp claws. They fly about at twilight, or on clear nights, hunting for mice and other small animals which they may happen to meet with, either asleep or active. They make their nests in old walls, in the clefts of rocks, or in hollow trees.

The Owls are divided into several genera, chiefly by the structure of their ears.

In the Eagle Owls the ear is an oval cavity, which occupies only half of the hollow in the skull. There are two large tufts of feathers on the head, which are popularly called ears.

Fig. a. The Eagle Owl (*Bubo maximus*) is the largest European species, and will attack even young fawns. It makes its nest in the clefts of rocks.

In the genus *Otus*, the ear is large and round, with a pointed flap, and these Owls have also two moveable tufts of feathers on the forehead.

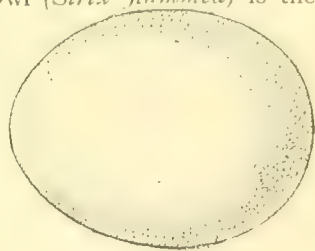
Fig. b. The Eared Owl (*Otus vulgaris*) is common in thick woods throughout Europe and the Northern parts of Asia and Africa. It feeds chiefly on mice, and should consequently be encouraged and protected.

The genus *Ulula* resembles *Bubo* in the structure of its ears, but has no tufts of feathers on the head.

Fig. c. The Brown Owl (*Ulula aluco*) likewise inhabits large woods, from whence it makes nightly excursions in pursuit of mice, moles &c. It is remarkable for its large broad cat-like head, but the body is much smaller than its loose plumage would lead one to suppose.

In the genus *Strix*, the ears resemble those of *Otus*, but the flaps are more complete, and the tufts on the head are wanting. The beak is only curved at the tip.

Fig. d. The Barn Owl (*Strix flammea*) is the handsomest and most familiar of our European Owls. The white ruff of feathers round the eyes is very conspicuous. It is found in nearly all parts of the world, except the extreme North, makes its nest in old walls and ruins, and feeds chiefly on mice.



Egg of Barn Owl

The genus *Athene* has also small tufts and rather small ears.

Fig. e. The Little Owl (*Athene noctua*) is common in many parts of Europe. It frequents human dwellings, and is found in church-towers, old buildings and hollow trees. Superstitious people regard its cry as a death-omen. This harmless bird feeds chiefly on mice, and is sometimes seen flying by day, pursued by a mob of wag-tails, swallows &c.

Order II. Scansores. (Climbing Birds.)

The peculiarity of this Order consists in the structure of the toes. In most species two toes are directed forwards, and two backwards, so that the birds are not only enabled to perch securely on branches &c., but also to climb easily up and down the trunks of trees.

Family I. *Psittacidae*. (Parrots.)

(Plate VI.)

The Parrots are true denizens of the tropics, and many of them are remarkable for their beautiful colours, and their great power of imitating the human voice, &c. Most of the species feed on roots and seeds and their strongly curved, and hooked beak, both mandibles of which are movable, is not only useful to crack hard shells, but is of great assistance to them in climbing from branch to branch. Different kinds are known as parrots, parakeets, macaws, lorries, cockatoos, &c.

In the Macaws (*Ara*) the beak is very large, with the ridge broad and flattened, the cheeks broad and naked, the wings long and pointed, and the tail longer than the body.

Fig. d. The Great Scarlet Macaw (*Ara macao*) is a large bird, measuring two feet in length. It inhabits primeval forests in the east of South America, far removed from human dwellings. Its plumage shines with the most brilliant colours, of which red is the most extended, and the naked cheeks, which look as if they had been powdered, are ornamented with small pencils of red feathers.

In the Parakeets the body is slender, the tail pointed, as long as the body, and the plumage usually of brilliant colours.

The Grass Parakeet (*Melopsittacus undulatus*) figured on the accompanying woodcut, is one of



The Grass Parakeet.

the smaller parrots. It is of a yellowish grass-green, with wavy blackish transverse lines. The forehead and cheeks are sulphur-yellow, and there are four tufts of blue feathers on the cheeks. In the female the cere is of a greyish green, instead of purple, as in the male. This species inhabits the grassy plains

of Australia in flocks. It is often kept in cages in Europe, and breeds readily in captivity.

Fig. e. The Alexandrine Parakeet (*Palaeornis Alexandri*) is said to have been first brought to Europe from India by Alexander the Great. It is grass-green, with a rosy-red beak and collar.

In the genus *Calyptorhynchus* the beak is short and crescent-shaped, the lower mandible very broad, the wings short and broad, the tail long, and the crest smaller than in the more typical Cockatoos.

Fig. f. Sir Joseph Bank's Cockatoo (*Calyptorhynchus Banksii*) is a rather scarce species found in New South Wales. It feeds on seeds, caterpillars &c. The colour of the male is greenish black, with a red transverse band across the tail.

(Plate VII.)

In the genus *Psittacus*, the beak is strong, moderately long, and curved almost in a half circle. The legs are short; and the toes long. The feathers are broad, and the eye is often surrounded with a bare space.

Fig. a. The Grey Parrot (*Psittacus erithacus*) is an inhabitant of Africa. Its colours are not remarkable, but it is one of the most intelligent species, and is often seen in cages.

In the Cockatoos (*Cacatua*) the colour is generally white, sometimes rosy, with an upright divided crest on the head.

Fig. b. The yellow-crested Cockatoo (*Cacatua galerita*) abounds in Australia, where it may be seen in flocks of hundreds. It is very docile, and easily taught.

Family II. *Ramphastidae*. (Toucans.)

(Plate VII.)

The Toucans are found in South America, and are remarkable for their disproportionately large beak, which is gradually curved, serrated at the edges and very light in proportion to its bulk. The bright colours of the beak observable in that of the living bird soon fade after death.

Fig. c. The Ariel Toucan (*Ramphastos Ariel*) is as large as a crow. It is black, varied with red and yellow, and feeds on fruits and insects.

Family III. *Picidae*. (Woodpeckers.)

(Plate VII.)

The Woodpeckers are the chief representatives of the Climbing Birds in Europe. They climb about the trunks and branches of trees, hammering at every loose scrap of bark in order to get at the insects which may be hidden beneath. Their toes, which are arranged in pairs, give them a firm support, which is increased by the stiff tail; their beak is sharp and very strong, and their tongue is long, and can be darted out rapidly.

Fig. d. The Black Woodpecker (*Dryocopus martius*) is found throughout Europe, Asia, and North Africa. It is most common in extensive mountain forests. The bird is black, with the crown of the head and the back of the neck red in the male; in the female this colouring is only found on the neck.

Fig. e. The Green Woodpecker (*Geococcyx viridis*) is smaller than the last species. The red markings on the head are less extended in the female than in the male. It is common in many parts of Europe.

Fig. f. The Great Spotted Woodpecker (*Picus major*), and

Fig. g. The Lesser Spotted Woodpecker (*Picus minor*), are likewise common European birds; the latter is not larger than a house-sparrow.

The Woodpeckers are among the handsomest and most active of our native birds, and any injury which they may be supposed to cause to trees is doubtless far more than compensated for by their services in destroying insects.

(Plate VIII.)

Fig. a. The Middle Spotted Woodpecker (*Picus medius*) is another species very similar to the two last. Its beak is rather small, and sharp. This bird frequents forests.

Fig. c. The Nuthatch (*Sitta europæa*) forms a transition to the Finches. The legs are short, and three toes extend forwards, and one, which consists of a single joint, backwards. The beak is hard, straight, and sharp, and the tail is short, and serves to support the bird when climbing. It is rather a pretty bird, and very active. It is common in most parts of Europe, and is often seen near houses.

Fig. b. The Wryneck (*Yunx torquilla*) has a short conical beak, and loose, very soft plumage. It resembles the woodpeckers in the structure of the tongue and in the position of the toes. The Wryneck is not an uncommon bird in Europe during the summer. It is of the size of a lark, and the general colour is grey, with brown transverse lines. It attracts attention by the peculiar twisted movements of its body, and does good service in destroying injurious insects.

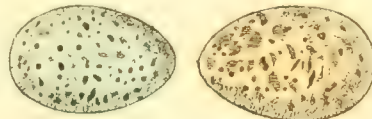


Egg of Wryneck

Family IV. **Cuculidæ.** (Cuckoos).

(Plate XI.)

Fig. g. The Cuckoo (*Cuculus canorus*) lays its eggs in the nests of other birds, and especially in those of small insectivorous birds. Its eggs are small in comparison with the size of the bird, and are of various colours. The



Eggs of Cuckoo.

Cuckoo inhabits woods, where it feeds on insects, and especially on the caterpillars which destroy forest trees. In the autumn it migrates southwards.

Order III. Syndactylæ.

In this small Order the outer toe is partly connected with the middle toe.

Family I. **Bucerotidæ.** (Hornbills.)

These birds have some resemblance to the Toucans, and are remarkable for the horny excrescence on their beak. The Two-horned Hornbill (*Buceros bicornis*) which is represented on the woodcut on page 8, is a native of India. Its prevailing hues are black and white.

Family II. **Alcedinidæ.** (Kingfishers.)

(Plate VIII.)

The Kingfishers have a curious truncated ap-

pearance. The head is large, and the beak is straight, large and strong. The feet and toes are small, and three toes are directed forwards, and one backwards, but the outer toes are connected with the middle one. The Kingfishers live on the banks of streams and lakes, and feed on small fishes and insects.

Fig. d. The Common Kingfisher (*Alcedo hispidæ*) is one of our most beautifully-coloured native birds. It makes its nest in burrows which it forms in clay banks, and lays from five to eight eggs on a layer of fish-bones.

Order IV. Passeres. (Singing Birds.)

The birds of this Order possess a peculiar structure of the larynx, which forms a singing apparatus, though they are not all able to sing. They are found in all parts of the world, and some feed on seeds, and some on insects; and a few, even among the smaller species, feed on small mammals and birds.

Family I. **Upupidæ.** (Hoopoes.)

(Plate VIII.)

Fig. f. The Hoopoe (*Upupa epops*) is remarkable for its long sharp bill, and large crest. It is found in many parts of Europe, Asia, and North Africa, being a summer visitant in Central Europe. It feeds on grubs, worms &c.

Family II. **Meropidæ.** (Bee-Eaters.)

(Plate VIII.)

Fig. e. The Bee-Eater (*Merops apiaster*) is another handsome bird. It has a very light and elegant flight, and pursues bees and other insects of

all kinds on the wing. It is a migratory bird, coming to Central Europe from the shores of the Mediterranean and Black Seas, and is sometimes seen in large flocks.

Family III. **Certhiidæ.** (Creepers.)

(Plate IX.)

Fig. a. The Tree-Creeper (*Certhia familiaris*) is a little bird hardly larger than a wren, which has a long narrow tongue like that of a woodpecker, a stiff tail, and toes with long claws, with which it can cling tightly to the trees when climbing. It is very active, often running about the lower side of the branches. It is found throughout Europe and Northern Asia.

Family IV. **Trochiliidæ.** (Humming Birds.)

(Plate IX.)

These beautiful little birds are only found in America, and the smaller species scarcely exceed a

large Humble-Bee in size. The bill is long and slender, either straight or curved, and the two mandibles form a regular tube, in which the tongue, which is cleft to the root, works like a double piston. They suck the honey of flowers, and also feed on small insects, hovering while they ply their long pointed wings with lightning-like velocity. On the wing they sometimes cannot be distinguished from moths of the same size, which hover over flowers in a similar manner. Many species are very brightly coloured, some of them shining like jewels. They form a delicate nest of about the size of a large apricot, which they build in the forks of slender twigs. We have figured the three following species:

Fig. b. The Little Humming Bird (*Melisuga minima*) a native of Jamaica and St. Domingo;

Fig. c. The Tufted Coquette (*Lophornis ornatus*) one of the commonest and most widely-distributed of the South American species; and

Fig. d. The Lazuline Sabre-wing (*Campylopterus curvipennis*) likewise common in Venezuela, and the neighbouring parts of South America.

Family V. **Corvidæ.** (Crows).

(Plate IX.)

In these birds the beak is strong, conical, laterally compressed, and generally longer than the head. The rounded nostrils are covered with small satiny or bristly feathers. They are very intelligent birds, and though most of them do not sing, they have a rather broad tongue, and some of them can be taught to articulate words distinctly. They are found in all parts of the world, and eat all kinds of food.

Fig. e. The Raven (*Corvus corax*) one of the largest of the family, is a bold and handsome bird. It is of a shining black colour, with a greenish blue metallic lustre. The beak is strongly arched, and the claws very powerful, so that it is enabled to attack both large and small animals, like a bird of prey. When captured young, it becomes very tame.

Fig. g. The Carrion Crow (*Corvus corone*) is considerably smaller and weaker than the Raven. Both birds are widely distributed over the Northern hemisphere. The Crow is frequently met with in large numbers in Southern and Central Europe, and destroys great quantities of mice and other small animals.

Fig. f. The Rook (*Corvus frugilegus*) has a longer and more pointed beak than the Crow, and

its plumage has a more metallic lustre. It is more omnivorous than the Crow and Raven, feeding on vegetable matters as well as on worms and insects. It is a very gregarious bird, nesting in large numbers on the same clump of trees. It is one of the commonest species of the family throughout Central Europe.

(Plate X.)

Fig. a. The Hooded Crow (*Corvus cornix*) much resembles the Carrion Crow in size, the structure of the beak, and habits. It is found in many parts of Europe and Asia, and is sometimes very abundant.

Fig. b. The Jackdaw (*Corvus monedula*) is a gregarious and very active bird, which may be seen flying by hundreds round the high trees and tall old buildings where it makes its nests. It feeds chiefly on insects, worms &c. It is rather smaller than the rook; the crown of the head is black, the cheeks and upper parts of the head are ashy-grey, there is a shining greyish-white spot on each side of the base of the neck, and the breast and belly are ashy-grey. The rest of the body is black. The Jackdaw is common throughout Europe.

Fig. g. The Magpie (*Pica caudata*) differs from the Crows and Rooks by its long tail. The prevailing colours of the bird are black and white, but the tail has a beautiful metallic lustre. It is a very cunning thief, and its nest, which it builds of thorns and twigs on lofty trees, is an almost impregnable fortress. The Magpie lives throughout the year in pairs. It

likes the neighbourhood of houses, and is common in all parts of Europe.

The Jays (*Garrulus*) differ from the Crows in the form of the beak, the points of which are curved together, the rounded tail, and the hopping gait.

Fig. c. The Jay (*Garrulus glandarius*) is one of the prettiest and best-known of our woodland birds. The wings are large, banded with black and white, and the wing-coverts are blue. The rest of the body is reddish-grey. The Jay feeds on insects, worms, berries and hard-shelled fruits, as well as on birds' eggs and young birds, which causes it to be regarded as a destructive bird.

Fig. d. The Nutcracker (*Nucifraga caryocatactes*) is dark-brown with scattered white spots. It is smaller than the Jay, and less common in most



Two-horned Hornbill (*Buceros bicornis*).

parts of Europe. It is a bold and thievish bird. It feeds on insects, berries and nuts, but will also kill small and even moderate-sized birds, attacking their heads.

The genus *Pyrrhonorax* has a rather long slender, curved beak, long wings, black plumage, and pale legs.

Fig. e. The Alpine Chough (*Pyrrhonorax alpinus*) inhabits the highest mountains of Europe, and is also found in Siberia, Persia and Egypt. It is gregarious, and makes its nest in the crevices of rocks, often in inaccessible places.

Fig. f. The Chough (*Fregilus graculus*) much resembles the last bird, but is more widely distributed in Europe; in Britain, it is frequently met with on rocky coasts, as well as inland. It is a shy, unsociable bird, and not easily tamed.

(Plate XI.)

Fig. a. The Roller-Bird (*Coracias garrula*) has a strong sharp beak, some bristles at the corners of the mouth, short legs, and brightly-coloured plumage. It is as large as a Jackdaw, but is of a bluish green colour, with the back cinnamon, and the legs yellow. It feeds on insects, worms and small frogs. It is a migratory bird, and is only seen in Europe during the summer months.

Family VI **Paradisoidæ.** (Birds of Paradise.)

(Plate XI.)

The Birds of Paradise, notwithstanding their magnificent plumage, are really closely allied to the Crows. The strong beak is straight or slightly curved at the tip, and covered with satiny feathers at the base. They are found in New Guinea and the Moluccas, and feed on insects, which they capture on the wing.

Fig. b. The Great Bird of Paradise (*Paradisæa apoda*) is not much bigger than a starling, but its long tail-feathers make it look much larger. There are from forty to fifty delicately-fringed feathers on each side of the body, which meet on the back, and surround the tail like a sort of feathery flower.

Family VII. **Rupicolidæ.** (Cocks of the Rock.)

(Plate XI.)

Fig. c. The Cock of the Rock (*Rupicola crocea*) is the representative of a small genus of brightly-coloured birds which inhabit various districts in South America. It is about the size of a ring-dove. The male is bright orange-yellow, and has a large crown consisting of a double row of feathers, which gives its head a superficial resemblance to that of a cock; the female is darker, and the hood is smaller. It forms its nest in the clefts of rocks, and feeds on seeds and insects, in search of which it scratches up the ground like a fowl.

Family VIII. **Sturnidæ.** (Starlings.)

(Plate XI.)

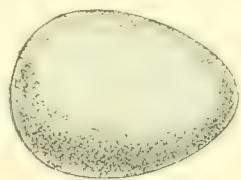
The Grackles (*Gracula*) have a knife-like beak, naked behind, a fleshy tongue, and legs fitted for walking.

Fig. f. The Hill Mina (*Gracula religiosa*) is an Indian bird, as large as a jackdaw. The plumage is blackish, with a violet lustre, the beak and legs are yellow, and a yellow lappet of skin surrounds the back of the head. It is a very favourite bird in India, as it is much more talkative than a parrot, and is readily taught to pronounce many words.

Fig. e. The Crow Blackbird (*Quiscalus versicolor*) is smaller than the last species. The male is black, with a purple lustre, and the female uniform brown. This bird is very destructive to the fields of maize in America.

(Plate XII.)

Fig. d. The Starling (*Sturnus vulgaris*) has a strong straight beak almost in a line with the top of the head. The legs are used for running on the ground, and not for hopping. It is a very lively bird, and easily learns to imitate various sounds and tunes both in the fields, and in captivity. It feeds on insects, seeds and berries. The Starling is abundant in many parts of Asia and Africa as well as in Europe.

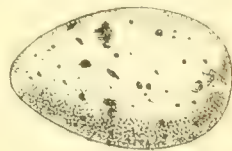


Egg of Starling.

Family IX. **Oriolidæ.** (Orioles.)

(Plate XI.)

Fig. d. The Golden Oriole (*Oriolus galbula*) is the type of this family. The male is shining gold-colour and black, and the female and young bird greenish. It is common in many parts of Europe, and has a melodious song.



Egg of Golden Oriole.

Family X. **Alaudidæ.** (Larks.)

(Plate XII.)

The Larks have a long awl-shaped spur on the hinder toe. They make their nests on the ground, run instead of hop, and feed on seeds and insects. Their song is very melodious.

Fig. a. The Sky-lark (*Alauda arvensis*) begins to sing very early in the year, while most other songbirds are still silent or absent. Its colours are plain. It is greyish brown above, with paler and darker stripes, and yellowish white beneath. It feeds on tender plants, as well as on seeds and insects. It is found in all parts of the Old World.



Egg of Skylark.

Fig. b. The Woodlark (*Alauda arborea*) notwithstanding its name, is generally seen on the ground, and but rarely on trees. It prefers clearings in woods, which are overgrown with heath, fern &c. It is smaller and less abundant than the Skylark, and its beak is more slender.

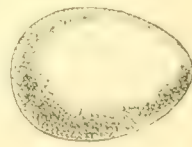
Fig. c. The Crested Lark (*Alauda cristata*) is distinguished by a pointed tuft of feathers on the head. The lower wing-coverts are of a fine rusty-red. These birds are fond of the neighbourhood of houses, but never perch on a high elevation. They build their nests on the ground, among vegetables, &c.

Family XI. **Turdidæ.** (Thrushes.)

(Plate XII.)

The first genus, *Cinclus*, has a narrow beak, with nostrils which can be closed at pleasure, short wings and tail, and long and strong legs.

Fig. e. The Dipper (*Cinclus aquaticus*) is an admirable swimmer and diver, and is almost always to be found in or near water, where it feeds on water-insects and their larvæ, and on small Crustacea, the fry of fish, &c.



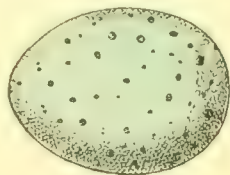
Egg of Dipper.

Its thick coating of feathers protects it both from the water and the cold. It is common throughout Northern and Central Europe and Asia.

In the Thrushes (*Turdus*) the nostrils do not close as in the Dipper; the wings and tail are longer; and the borders of the eyelids and the corners of the beak become yellow in the pairing-season.

The Thrushes are distinguished from all the other singing birds by their legs being covered with a horny plate before and behind. The beak is moderately long, and ends in a curved point. The feet and toes are large. Their song is strong and melodious.

Fig. f. The Song Thrush (*Turdus musicus*) is olive-brown above, and yellowish white beneath, with brown spots. It feeds on insects and berries, and makes its nest in bushes. It is a very common bird, and is seen throughout the year.



Egg of Song Thrush.

(Plate XIII.)

Fig. a. The Missel Thrush (*Turdus viscivorus*) is very like the last species, but larger. It is found in all parts of Europe, and prefers pine forests. It is very voracious, feeding on snails, worms, insects and berries, especially those of the mistletoe, from which it derives its name. In some countries it is esteemed as a dainty, as is also the next species.

Fig. b. The Fieldfare (*Turdus pilaris*) is a winter visitor with us. It is abundant in the more northern parts of Europe, where it breeds. It is very fond of the berries of the juniper.

Fig. c. The Ring Ouzel (*Turdus torquatus*) is one of the larger thrushes. Its plumage is black, and its feathers are bordered with whitish. On the upper part of the breast is a broad crescent-shaped white band. It is a very shy and retiring bird, and is found in wooded and mountainous districts in many parts of Europe. Its song is not remarkable.

Fig. d. The Blue Thrush (*Turdus cyaneus*) inhabits the mountains of Southern Europe. The male is dark slate-blue, suffused with bright sky-blue, and the wings and tail-feathers are black, bordered with blue.

Fig. e. The Blackbird (*Turdus merula*) is one of our commonest English birds. The male is black, with a yellow beak, and the female is dark brown. It is found throughout Europe, and lives in woods and thickets; and like most other thrushes, comes close to houses, and is frequently seen in gardens, even close to large towns. It begins to sing in March, but remains with us throughout the year.

Fig. f. The Bohemian Wax-wing (*Ampelis garrula*) has a short beak, compressed from above downwards, and strongly toothed. The plumage is soft and silky and the legs are short and strong. This bird is remarkable for the curious red sealing-wax-like appendages on some of the wing-feathers, and occasionally in the tail also. It makes its nest in the dark pine-forests of the extreme North of Europe, and only migrates to more temperate climates in very severe winters. It is a harmless indolent bird, and feeds on insects and berries.

(Plate XVII.)

The Nightingales hop on the ground, moving their tail up and down. The legs are rather long, giving the birds an upright posture, and the straight slender beak has exposed nostrils. They are small

and active birds, with slender beaks, and generally rather uniform plumage, though they are the most charming songsters among our native birds. They live on insects, seeds and berries. Most of them are true birds of passage, and only visit us during the summer months.

Fig. a. The Nightingale (*Daulias luscinia*) is brown above, with a reddish lustre, and beneath pale grey and dirty white; it is about the size of a sparrow. Its northern range in Europe extends to Central Sweden; in England it is most frequently met with in woods and gardens in the Eastern and Southern counties.

Fig. b. The Blue-Throated Warbler (*Cyanecula suecica*) is generally found among low brush-wood near water. Its colour and voice are equally charming. It appears in Central Europe in April, hatches four or five eggs in an artistically constructed nest, and migrates to the south in August or September.

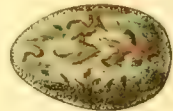
(Plate XVIII.)

Fig. a. The Robin (*Erythica rubecula*) has an olive-brown tail and wings, and a red breast. Its song is very melodious, but has a somewhat melancholy tone, especially in the evening, when the other birds are silent. It is found in all parts of Europe.

The Warblers (*Sylvia*) are distinguished from the Nightingales by their short strong legs, rather large beak, and more stooping posture. They glide actively among the bushes, but are awkward in their movements on the ground.

(Plate XVII.)

Fig. c. The Blackcap (*Sylvia atricapilla*) is another melodious songster, which, like the Nightingale, exhibits nothing striking in its colours. It is dark grey above, and much paler below. The crown of the head is black in the male, and brown in the female.



Egg of Blackcap.

Fig. d. The White-Throat (*Sylvia cinerea*) is brownish grey above, and dirty yellowish or reddish white beneath. It is a slender, lively and industrious little bird, which is found throughout Europe.

Fig. e. The Garden Warbler (*Sylvia hortensis*) is olive-grey above, and dirty yellowish-white beneath, and is common in the warmer and temperate parts of Europe, where it is common in gardens, and makes itself useful by destroying insects. Its song is the most charming of any bird of the genus.

Fig. f. The Snow Whitethroat (*Sylvia curruca*) much resembles the last species, but is smaller. It inhabits Central Europe in summer, where it is seen hopping about in gardens and among bushes.

(Plate XVIII.)

Fig. d. The Redstart (*Phoenicurus ruticilla*) is a brightly-coloured, active bird. The back is ashy-grey, the throat black, the breast and tail rusty-red, and the wings brown. It enlivens the fields and gardens with its cheerful song throughout the summer.

(Plate XVII.)

The species of *Hypolais* have a long pointed head, and slender beak and feet. They hop about trees, and move clumsily on the ground.

Fig. g. The Icterine Warbler (*Hypolais icterina*) is greenish grey above, and pale sulphur-yellow beneath. It is found in Central Europe in bushy gardens and small woods, and is met with as far north as Central Sweden. It has a varied and melodious song.

Family XII. **Troglodytidae.** (Wrens.)
(Plate XVIII.)

The birds belonging to the genus *Regulus* are very small and active creatures, with a straight pointed beak, on which the nostrils are covered with a small comb-like feather.

Fig. b. The Golden-Crested Wren (*Regulus cristatus*) and its near ally, the Fire-Crested Wren (*Regulus ignicapillus*) are among the smallest of European birds; measuring not much more than three inches in length. The Golden-Crested Wren may be seen darting about trees and hedges throughout the day in search of insects.

Fig. c. The Wren (*Troglodytes vulgaris*) is a little larger than the last-mentioned birds. Its colour is rusty brown, with dark transverse stripes. Its tail is rounded. It is a very lively and cheerful little bird, which utters its loud shrill song even during the winter. Egg of Wren. The Wren is common throughout Europe, and frequents bushy places near water.

The genus *Pratincola* is distinguished by its long legs, short tail, and the peculiar shape of the beak, which is broad at the base, and somewhat truncated in front.

Fig. f. The Whinchat (*Pratincola rubetra*) inhabits Southern and Western Europe, and is found in meadows among low herbage and clumps of trees.

The genus *Motacilla* has a rather long, straight, slender beak, long legs, and a long tail, which it is always wagging.

Fig. g. The White Wagtail (*Motacilla alba*) has a plain colouring of grey, white and black. It is common throughout Europe, and is a very lively bird, always running about, especially near water, where it builds a simple nest in holes in the ground, under bridges &c. A very similar bird, the Water Wagtail (*M. Yarellii*) is common in England.

Fig. h. The Yellow Wagtail (*Motacilla flava*) is a handsomer bird than the last species. The head is bluish green, the back olive-green, the whole under-surface of the body bright yellow, and the tail brownish black, except the two outermost feathers, which are white. The long claw on the hinder toe shows it to belong to the running birds, and in fact it generally lives on the ground, where it makes its nest among roots, the stems of reeds, &c. It is a migratory bird, and is found throughout Europe, even to the extreme north.

The genus *Acrocephalus* has a long flat forehead, strong legs, and a stooping posture. The species live near the water among reeds and bushes, and climb about the stalks of the reeds with great celerity.

Fig. e. The Great Reed-Warbler (*Acrocephalus arundinaceus*) was formerly considered to be a Thrush, on account of its size (it measures eight inches in length). It is of a yellowish grey above, and greyish white beneath. It builds a large basket-like nest at a height of two feet above the water, which it attaches to three or more reed-stems.

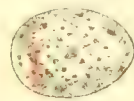
Family XIII. **Paridae.** (Titmice.)
(Plate XIX left side.)

This family contains small, but active and intelligent birds. They are chiefly insect-eaters, but their short strong beak is likewise adapted for break-

ing open hard-shelled seeds, which they hold steady between their toes for the purpose. Their legs are short and strong, and they climb easily with their strongly curved claws. Their plumage is soft and long, and in some species is prettily coloured.

Fig. a. The Great Titmouse (*Parus major*) is one of the best-known, as it visits our gardens in winter. At other times it lives in the woods, and is also met with at a considerable elevation in the mountains. It destroys great numbers of insects.

Fig. b. The Blue Titmouse (*Parus caeruleus*) is olive-green above, and yellow beneath, with the wings and tail blue. It is a very lively bird. It inhabits all Europe, except the far North.



Egg of Blue Titmouse.

Fig. c. The Cole Titmouse (*Parus ater*) has a black head and neck, the cheeks and a longitudinal stripe on the back of the neck are white, the back is ashy grey, and the belly whitish. It is found through Europe, Asia and America in woods, and most often in pine woods, where it makes its nest on the ground in hollow stumps &c.

Fig. d. The Crested Titmouse (*Parus cristatus*) has a pointed tuft of black and white feathers on the head; the throat and a stripe over the eyes black, the back greyish brown, and the belly whitish. It feeds on insects, and frequents pine-forests, like the last species.

Fig. e. The Marsh Titmouse (*Parus palustris*) is the most lively of all the Titmice, and surpasses the rest in climbing. It is found in woods in most parts of Europe.

The Long-tailed Titmouse (*Parus caudatus*) is white on the top of the head, and on the under-surface of the body, and the whole of the upper-surface is black, with the shoulders reddish brown, the hinder wing-feathers are broadly bordered with white on the outer side, and the two outer tail-feathers are white on the outer side and at the end. It lives in pine-forests and builds a purse-shaped nest among the stalks of the reeds.

Family XIV. **Fringillidae.** (Finches.)
(Plate XIV.)

The Finches are small prettily-coloured birds, with a short strong conical beak, which in some species is curiously hooked and crossed at the tip, with which the birds crack the grains and seeds on which they feed.

The genus *Loxia* is easily known by the large head and strong beak, the tips of which are curved and crossed. They are hardy birds, which live in pine forests, and feed on pine and fir-cones, and begin to breed very early in the year.

Fig. a. The Crossbill (*Loxia curvirostris*) is six or seven inches in length. The full-grown male is of a nearly uniform carmine-red, and the female and young birds greyish or yellowish green. It inhabits Northern and Central Europe.

The genus *Pyrrhula* has a short thick beak, rounded on the sides, and short legs, which unlike those of the Crossbill, are not adapted for climbing. They feed on buds and seeds.

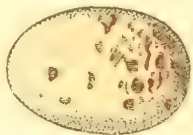
Fig. b. The Pine Grosbeak (*Pyrrhula cuculinator*) is a handsome bird, coloured something like the Crossbill. The old birds are for the most part carmine-red, with two white stripes on the wings, and the females and young are ochre-yellow and grey. The beak is strongly hooked, but not crossed.

Fig. c. The Bullfinch (*Pyrrhula vulgaris*) is better known than the last species, and is met with throughout Europe, as far north as Central Sweden. It is found in woods, and in the more northern parts of Europe, is only a summer visitant.

The species of *Coccothraustes* have the largest and most powerful beaks of all the Finches. The lower mandible is furnished with a protuberance in order to shell hard seeds.

Fig. d. The Greenfinch (*Coccothraustes chloris*) is a strongly-built bird, with a large head and a short tail. It is found in Europe, North Africa, and Northern Asia, and is generally to be seen on the edges of woods, near meadows where poplars and willows grow, on which it likes to build its nest. It is a migratory bird in some parts of the Continent, though a permanent resident in England. It feeds chiefly on oily seeds.

Fig. e. The Hawfinch (*Coccothraustes vulgaris*) has a heavy, clumsy appearance, but flies well, and climbs actively about the trees. It is common in many parts of Europe.



Egg of Hawfinch.

In the genus *Emberiza*, the beak, as in *Coccothraustes*, is adapted to the food of the birds. They feed on insects and seeds, which they pick up from the ground, and the upper mandible of their beak is provided with a knob on the palate for cracking seeds.

Fig. f. The Yellow Hammer (*Emberiza citrinella*) is the most familiar species of this genus. In winter it comes near houses, and in summer it is to be seen everywhere in the woods and fields. It makes its nest twice a year in low bushes and hedges, and during this time the silvery note of the male is constantly to be heard. The male is more brightly coloured than the female, in which the colour inclines towards greyish brown, varied with olive-green.

Fig. g. The Ortolan (*Emberiza hortulana*) is smaller than the Yellow Hammer, and less brightly coloured. The yellow on the throat and upper part of the breast is of a light sulphur-colour. The upper part of the head and the neck are ashy grey, the belly and the lower tail-coverts are rusty-yellow, and the back and shoulders are rust-coloured. The Ortolan inhabits Central and Southern Europe, and is esteemed a great delicacy.

(Plate XV.)

Fig. a. The Cirl Bunting (*Emberiza cirlus*) is a native of Southern Europe, but migrates into Central Europe, where it is rather a scarce bird, though it sometimes breeds in hedges. It is one of the handsomest birds of the genus; the head, the back of the neck, and the breast are olive-green, the cheeks are yellow, and the chin and borders of the cheeks of a fine brownish black, the rump dirty olive-green, and the back and wings rusty-red.

(Plate XVI.)

Fig. f. The Common Bunting (*Emberiza miliaria*) is the largest of the genus, and is generally to be seen upon the ground. It is found throughout Europe, and remains with us throughout the year, but in colder regions it migrates southward during the winter months.

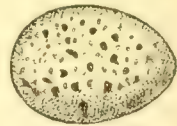
(Plate XV.)

Fig. b. The Snow Bunting (*Plectrophanes nivalis*) exhibits a transition to the larks. It has a

spur on the hind toe, long narrow wings, and a short tail, and is generally seen upon the ground. It inhabits Northern Europe, Asia and America, and migrates to the south in great flocks during winter. The younger birds are of a dark greyish brown on the head, back and wings, and dirty white beneath, suffused with rusty brown. As they grow older, the pure white of the under-surface of the body contrasts much more strongly with the deeper brownish black of the upper-surface.

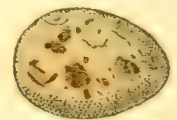
The genus *Fringilla* and its allies include some of the best singers and most favourite cage birds among the Finches. They are finely formed, and some of them are very prettily coloured. They have a conical pointed beak, which varies in length and breadth in different species.

Fig. c. The House Sparrow (*Passer domesticus*) is by far the commonest and most ubiquitous of all our birds, forcing itself under our notice everywhere, even in the heart of London. It feeds on almost everything, and naturalists are by no means agreed as to whether the service which it renders in destroying insects is greater or less than the damage which it undoubtedly inflicts upon many of our field and garden crops. It was introduced into North America in the hope that it would destroy injurious insects, but instead of this, it is now regarded in that country as a most troublesome pest.



Egg of House Sparrow.

Fig. d. The Chaffinch (*Fringilla coelebs*) is a very common bird in many places, and is much admired for its handsome colours and cheerful song, which includes several tones. The male is very handsome in his bridal dress; the front of the head is black, the back of the neck slaty-blue, the back reddish brown above, and the sides brown, the throat and breast reddish brown, with white and yellowish white bands across the wings. This bird is found through Europe, and in many parts of Africa and Asia.



Egg of Chaffinch.

Fig. e. The Mountain Finch (*Fringilla montifringilla*) is found in the north of Europe, and migrates to the south in immense flocks. It is quite as handsomely coloured as the last species, especially in autumn, when the male acquires his shining blue-black back and head, with brownish borders to the feathers, and his beautiful orange-coloured breast. Like the last species, they build very skilfully-woven nests in the thick branches of birch and pinetrees. In summer, they nourish themselves and their young with insects, and in autumn and winter they feed on oily seeds, especially beech-mast, of which they are extremely fond. They are very quarrelsome birds.

Fig. f. The Snow Finch (*Montifringilla nivalis*) inhabits mountainous regions, on the borders of the eternal snow. Here it lives in large flocks, feeding on insects and seeds, and making its nest in the clefts of the rocks. The head and neck of the male are ashy grey, the back and shoulders are brown, the chin whitish, the throat black in summer, the breast greyish white, and the wing-feathers black, except those in the middle, which are snow-white, while the tail is black in the middle, and white on the sides.

(Plate XVI.)

Fig. a. The Goldfinch (*Fringilla carduelis*) is the most beautiful of all our smaller birds. It is

common throughout Europe, and a great part of Asia. In addition to its beauty, it is a lively little bird, and has a pleasant song. It often makes its elegant nest in fruit-trees near houses.

Fig. c. The Linnet (*Fringilla cannabina*) is one of the commonest of the seed-eating finches; its song is clear, strong and flute-like. In spring the crown of the head, and the upper part of the breast of the male are adorned with fine carmine-red, and the rest of the plumage is brown and grey, which are the ordinary colours of the female and the young. The Linnet is found in woods and fields in all parts of Europe.

Fig. d. The Siskin (*Fringilla spinus*) attracts attention by its lively ways, and well-sustained, though not remarkable song. It is common throughout Europe, and is always seen in large flocks. It feeds on the seeds of pines, firs, birch and alder, and makes its nest among these trees and bushes. The male has a black crown and black throat, and the rest of the plumage is of a fine yellowish green; in the female it is more grey.

Fig. e. The Citril Finch (*Fringilla citrinella*) is yellowish green, but the neck is ashy grey on the back and sides. The bird is rather longer than the Siskin, and its beak is more obtuse. It is confined to the southern parts of Europe.

Fig. b. The Canary (*Serinus canarius*) which was first brought from the Canary Islands three hundred years ago, is now completely acclimatised in Europe. It is now dispersed throughout the world as a favourite cage-bird. It is very tame and intelligent, and the male is a charming singer.

Tribe V. Fissirostres.

(Plate XIX.)

These birds are distinguished by their deeply-cleft beak, which is rather curved at the tip, and by the unusually wide gape, which opens to behind the eyes. Their legs are weak, and their toes small, but their powers of flight are immensely developed. Want of food compels them to migrate to tropical countries in autumn, and they return in spring, often making their nests in the same spot as before.

Family I. Hirundinidæ. (Swallows.)

The Swallows and Martins have a short beak, weak legs, pointed wings, and in most cases a forked tail.

Fig. a. The Chimney Swallow (*Hirundo rustica*) is shining black above, with the forehead and throat brownish-red, and the rest of the under-surface of the body yellowish-white. It makes its nest under the eaves of houses, and sometimes in outhouses and stables, confiding in protection, and willingly making itself a domestic animal. Its arrival is welcomed everywhere as a sign of spring.

Fig. b. The House Martin (*Chelidon urbica*) is black above, with the throat and under-surface of the body white. It does not fly so rapidly as the



Egg of Goldfinch.

swallow, and builds its nests, often in considerable numbers together, on the outside of houses. It arrives in England in spring a few days later than the Swallow, and assembles in flocks on roofs &c., in the autumn, before departing for the South.



Egg of House Martin.

Fig. c. The Sand-Martin (*Cotile riparia*) is mouse-coloured above, and white beneath, with a grey transverse band on the head. It is one of the smallest of the European swallows. It is generally seen near rivers and streams, and it makes its nest in burrows in the banks.

Family II. Caprimulgidæ. (Goatsuckers.)

(Plate XIX.)

The Goatsuckers have a much wider gape than the Swallows, which is surrounded by stiff bristles. The beak is small, the hind toe movable, and the plumage very soft.

Fig. d. The Goatsucker (*Caprimulgus europæus*) has brownish-grey plumage, speckled with black and white. It is a night-flying bird, and is not uncommon in the woods of Central and Southern Europe. A strange idea was long prevalent that this bird was in the habit of sucking milk from goats.

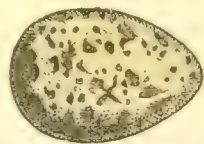
Tribe VI. Dentirostres.

(Plate VI.)

These birds have a slightly curved beak, like that of a bird of prey, with a tooth in the upper mandible, and feed on small mammals and birds, as well as on insects. But their song, which they can modify to imitate the voices of very different kinds of birds, indicates them as belonging to the singing birds. Their colouring is rather monotonous, and all our indigenous species are marked with a black streak near the eyes.

Family Laniidæ. (Shrikes, or Butcher-Birds.)

Fig. a. The Great Grey Shrike (*Lanius excubitor*) is nine or ten inches long, and fifteen inches in expanse of wing. Notwithstanding its comparatively small size, it feeds on birds as large as thrushes, and even partridges, as well as on young birds and mice. It is found in all parts of Europe, and is in very ill repute, on account of its destroying useful birds.



Egg of Great Grey Shrike

Fig. b. The Red-backed Shrike (*Lanius collurio*) is the smallest and prettiest of the European species. Its song is excellent, but is always composed of snatches of the songs of other birds. It arrives in May, and leaves in August. It is met with in Europe, Asia, Africa, and North America, and prefers well-wooded districts.

Fig. c. The Lesser Grey Shrike (*Lanius minor*) inhabits Central and Southern Europe. It is found chiefly in woods, where it makes its nest on thick branches, using odoriferous plants for the purpose.

Order V. Columbæ. (Pigeons.)

The Pigeons form a small Order of birds which are very uniform in character. The beak is soft and slender at the base, and slightly curved at the tip, and the nostrils are placed on a raised cartilage. Their long pointed wings are fitted for very rapid

flight, the legs are short, and the hind toe is perfectly developed, and placed at the same level as the others. They live in pairs, and build neatly constructed nests in the clefts of rocks, in trees, or among shrubs.

(Plate XX.)

Fig. a. The Rock Dove (*Columba livia*) which is found wild in many parts of Europe, is believed to be the original stock from whence all our numerous varieties of tame pigeons are derived. The prevailing colour is a paler or darker bluish-grey, the neck shines with blue and purple shades, and there are two black transverse bands on the wings.

Fig. b. The Trumpeter is remarkable for its peculiar long-sustained and resounding coo. The legs and feet are covered with very long feathers.

Fig. c. The Tumbler has short, naked feet, a small round head, and large pearl-coloured eyes. It is remarkable for a swift and rapid flight, during which it turns over and over in the air.

Fig. d. The Tern Pigeon is a small breed with an unusually small beak, and several rows of raised feathers running from the middle of the throat over the breast, which form a distinct ruff.

Fig. e. The Fan-tail is a little smaller than the Rock-dove, and has a large tail of from 28 to 32 feathers, which it can spread like a peacock.

Fig. f. The Nicobar Pigeon (*Columba nicobarica*) is more like a domestic fowl than a pigeon, both in form and habits. It has long feathers hanging down on the sides of the neck. It lives mostly on the ground, and makes its nest under bushes. It inhabits the Nicobar Islands, the Malay Islands, and the Moluccas.



Egg of Stock Dove.

(Plate XXI.)

Fig. a. The Stock Dove (*Columba ænas*) may be distinguished from the Rock Dove by the absence of the black bands on the wings; the white colour beneath the wings and on the back; the reddish-yellow beak, and the more slender form. It is common in Europe, but is only seen in summer in the colder districts. It inhabits woods.

Fig. b. The Pouter is another of the strange domesticated varieties of the Rock Dove. It can inflate the skin of its neck to an amazing extent, and its voice is a dull hollow coo.

Fig. c. The Passenger Pigeon (*Ectopistes migratorius*) has a long pointed tail of twelve feathers, and long pointed wings, adapted for rapid and long-sustained flight. It inhabits North America, and migrates in vast flocks for hundreds of miles from one spot to another.

Fig. d. The Laughing Pigeon (*Columba risoria*) came originally from Africa, but has long been domesticated in Europe.

Fig. e. The Turtle-Dove (*Turtur vulgaris*) is bluish-grey on the head and neck, and the breast is purplish. The sides of the neck are ornamented with scattered ring-like series of feathers. It is a very pretty dove, and very easily tamed.

Fig. f. The Crowned Pigeon (*Goura coronata*) is one of the largest of the family, and is not much smaller than a hen turkey. It is of a slaty-blue colour above, with reddish-brown white-striped wing-coverts, and has a beautiful crest on the head. It is found in New Guinea.

B. AUTOPHAGI.

Order VI. Gallinae. (Game Birds.)

The strong beak is hard to the root; the head is always ornamented with bare spaces, or spongy excrescences (called the comb and wattles); the wings are generally short, and the flight heavy, the tail consists of stiff feathers, which can be raised and expanded like a fan in many species; the legs are strong, the toes are furnished with blunt claws for scratching up the ground, and the hind toe is placed higher than the others, and is generally rudimentary. The male is generally provided with a sharp spur above the hind toe, as a defensive weapon. They are found on heaths, and in meadows and woods, and generally feed on grains and seeds which they pick up from the ground. Many species are reared for their flesh and eggs.

Family I. Tetraonidæ. (Partridges.)

(Plate XXI.)

The Quails have a small and somewhat raised beak, a short tail, entirely concealed beneath the feathers of the rump, and no spurs on the legs. They are found in cornfields, and live a very secluded life.

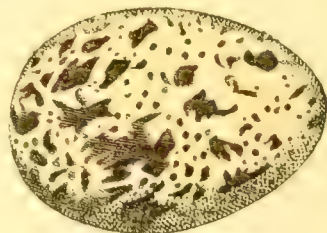
Fig. g. The Quail (*Coturnix communis*) is not much more than half the size of a partridge, which it resembles in habits and appearance. It is

common in many parts of Europe, where its short sharp cry is frequently heard in the fields.

(Plate XXII.)

The Grouse have a short thick sharply-ridged beak, upon which the nostrils are surrounded by a thickly-feathered membrane. There is a red crescent-shaped naked skin over the bare eyelids. The forehead and the throat are feathered. The short strong legs are feathered either to the toes or to the shanks. They mostly frequent wooded districts in mountainous countries, and none of the species are migratory.

Fig. a. The Ptarmigan (*Lagopus mutus*) inhabits mountains in the northern parts of Europe and Asia, and is furnished with a covering of hair-like feathers, to the toes. It is mottled with darker in the summer, and becomes white in winter. It feeds on the buds and leaves of low-growing Alpine plants, and never perches on trees, but digs long galleries



Egg of Ptarmigan.

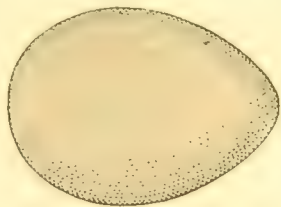
in the snow in winter with its long shovel-like claws. Its flesh is much esteemed for the table.

Fig. b. The Black Grouse (*Tetrao tetrax*) is as large as a moderate-sized cock, and is a beautiful bird. The cock has black plumage, shading into blue on the head, a white band on the wings, and a curved and forked tail. The female is rusty-brown, and her tail is not forked. It is an extremely shy and wary bird, and is more common in Northern than in Central Europe. It feeds on tender shoots and leaves. The young are hatched in a rough nest among heath, and feed at first on insects, ant's eggs, &c. They vary from six to fifteen in number.

Fig. c. The Capercaillie (*Tetrao urogallus*) is considerably larger than the last species, and is one of the handsomest birds which inhabit the forests of Europe. Our figure represents the cock bird, who is adorned with a black tuft of feathers under the chin. The female is much smaller, and almost uniform reddish brown. The Capercaillie is found in all the mountainous parts of Northern Europe and Siberia, where it feeds on berries, pine-needles, fir-cones, &c. It has lately been reintroduced into Scotland, (where it had become extinct,) from Norway. It is in season in March and April.

In the Partridges, the head is clothed with feathers above the eyebrows, and there is a small bare triangular space behind the eyes. The short, moderately arched beak is only slightly hooked, and the nostrils are free from feathers. The moderately long legs are not feathered, and the wings are short. They feed more on grubs and insects than on corn, and frequent the open fields, where they run better than they fly.

Fig. d. The Partridge (*Perdix cinerea*) has greyish feathers with dark brown stripes and blotches, and the male has a brown horse-shoe shaped mark on the breast. The bird looks like a clod of earth at a little distance, and this serves as a great protection against its numerous enemies. It rises from the ground with a heavy flight and loud chattering cry, but then skims away with great swiftness at a moderate height from the ground. In England it is generally sought for in stubble-fields, but on the Continent it likewise frequents vineyards.



Egg of Partridge.

Fig. e. The Red-legged Partridge (*Caccabis rubra*) is rather larger than the last species; the cheeks and throat are white, bordered outside by a broad black band; the back of the head and neck are reddish brown, the back is reddish grey, the breast and sides ashy grey, with black white and rusty transverse bands, the belly yellowish red, the four middle tail-feathers reddish grey, and the other twelve rusty red. The beak and legs are bright red. It is found in the south of Europe, and in the adjacent parts of Asia and Africa.

Fig. f. The Greek Partridge (*Caccabis saxatilis*) may be distinguished from the last species by the sharply-defined black band which surrounds the white throat, and by the bluish-green feathers on the sides, which are marked with a rusty-yellow transverse stripe between two black ones before the dark reddish brown tips. This bird inhabits the mountains of Southern Europe and Asia, and Northern Africa.

Family II. Phasianidæ. (Pheasants.)

(Plate XXII.)

The domestic Fowl and its allies have a raised comb on the top of the head, two wattles, or bare folds of skin under the throat, and a tail composed of fourteen feathers, in which the large tail-coverts are considerably lengthened in the cock, when he has attained two-thirds of his growth. In the wild hen the comb and wattles are replaced by feathers.

Fig. h. The Cock (*Gallus bankiva*, var.) There are a great number of breeds of domestic fowl, varying very much in size, colour, and even habits. We have figured one of those which resemble the original Jungle Fowl (*Gallus bankiva*) of Java, from which our domestic breeds are believed to have been derived.

(Plate XXIII.)

The Pheasants are the most beautiful birds of their Order. They are generally of considerable size, and the plumage of many species, at least in the male birds, is magnificent. The tail frequently attains an extraordinary development, and in some species can be spread out like a fan.

The Pheasant (*Phasianus colchicus*) is a native of Western Asia, but has long been acclimatised in Europe. It is reddish-brown, with the head and neck greenish blue.

Fig. a. In the Silver Pheasant (*Euplocamus nycthemerus*) the male is silvery white and bluish black, and the female is yellowish brown and dirty white. It is a native of China, but is often seen in menageries, and sometimes in large poultry-yards.

Fig. b. The Golden Pheasant (*Thaumalea picta*) is also a Chinese bird; and is generally to be seen in Europe in company with the last.

Fig. c. The Argus Pheasant (*Argus gigantus*) is nearly as large as a peacock, measuring five feet in total length; the female is much smaller than the male. It inhabits Sumatra, Malacca, &c. where its colours assimilate so well with the surrounding woods that it is almost impossible to catch a sight of the bird itself.

In the genus *Pavo* there is a crest of long feathers on the head. There are eighteen tail-feathers, which are curved inwards, and overlapped by the long tail-coverts, which are extremely developed in the male, and most beautifully coloured, and can be raised like a fan with the aid of the tail-feathers. The Peafowl inhabits the East Indies.

Fig. d. The Peacock (*Pavo cristatus*) was brought to Greece from India by Alexander the Great, and has since spread over Europe, where it is justly admired as the largest and most beautiful of our domesticated birds. The Peacock has his drawbacks, however. He is fond of perching on trees and roofs, and uttering his shrill unmusical cry. He is a savage bird, and at times dangerous. A white variety of the Peacock is sometimes reared.

Fig. e. The Impeyan Pheasant (*Lophophorus impeyanus*) is another very beautiful bird, classed by some authors with the Peafowl. The female is inconspicuously coloured, with brown, grey and yellowish markings, but the male has the head, neck, and back magnificently shining with metallic green, red and yellow. The hinder part of the back is white, the tail reddish brown, and the belly black. It is found in the mountains of Northern India.

(Plate XXII.)

In the genus *Numida* the head and neck are bare, and there is a naked fold of skin on each side of the upper mandible, and a very short tail, concealed beneath the tail-coverts.

Fig. g. The Guinea Fowl (*Numida meleagris*) inhabits swampy regions in Africa, where it lives in flocks of two or three hundred together, and roosts at night on trees. The bare head, ornamented with a brownish horn-like protuberance, gives it a peculiar appearance. The colour of the feathers is pretty, especially the pearly white spots on a bluish-grey ground. The Guinea Fowl is a quarrelsome bird, and has a very disagreeable cry. Its flesh is delicate, and its eggs, of which a hen will lay sixty or seventy in the course of a summer, are also much esteemed.

Family III. **Meleagridæ.** (Turkeys.)

(Plate XXIII.)

In the Turkeys the head and upper part of the neck are bare, and covered with warts. There is a pendant fleshy protuberance on the forehead. The tail, which consists of 18 feathers, is rounded, and is often spread out like a fan by the male.

Fig. f. The Turkey (*Meleagris gallopavo*) is a native of America, but derives its name from its having been erroneously supposed to be a native of the East. The wild Turkey of the United States is a much larger and handsomer bird than the tame ones, measuring four feet in length. The head and neck are of a rich blue, and the dark brown plumage shines with beautiful coppery, purplish-red, and green metallic hues. Turkeys are reared for the sake of their eggs and flesh; but the Turkey Cock, like the males of most of the Game-Birds, is very easily irritated.

Order VII. **Cursores.** (Running Birds.)

(Plate XXIV.)

This Order, which includes the largest existing birds, may be known by the imperfectly developed wings, and the smooth, convex breastbone, which is not provided with a ridge. On the other hand the legs are greatly developed. They have either two or three toes, with expanded soles and flattened claws. A hind toe is entirely absent.

The beak is short and flattened, and the head and neck are either naked or clothed with short down. In most cases the tail consists only of a tuft of flossy feathers.

Family I. **Struthionidæ.** (Ostriches.)

Fig. c. The Ostrich (*Struthio Camelus*), the largest living bird, exceeds seven feet in height when full-grown, and weighs two hundred pounds. Its general colour is black, but the large drooping feathers of the wings and tail are white, and form a valuable article of commerce. Its speed and powers of endurance are great, and it can easily distance a horse. Ostriches are found in large flocks in the sandy deserts of Africa and the adjoining parts of Asia. Their eggs, which weigh three pounds, are hatched by the females in rough nests formed in the sand.

Family II. **Rheidæ.** (Rheas.)

Fig. d. The Rhea, or American Ostrich (*Rhea americana*) is smaller than the African bird, which has only two toes, while the American bird has three.

In the Rhea, the fine plumes of the tail are absent, and the general colour is grey, the wings being paler; and there are black streaks on the neck of the male. They inhabit the great plains of the southern districts of South America.

Family III. **Casuaridæ.** (Cassowaries.)

Fig. b. The Cassowary (*Casuarus galeatus*) is a native of the Moluccas. It measures five feet in height, and is a stouter bird than the Ostrich or the Rhea. The Cassowaries have a raised horny or bony helmet on the head, hairlike feathers, and three toes on the feet. The plumage in the species figured is black, and the bare skin and wattles on the head and neck are blue and red.

Family IV. **Apterygidæ.**

These birds have three large toes in front, and a very short toe behind. The beak is long and slender, and the plumage hair-like, without wing-plumes or tail-feathers.

The Apteryx (*Apteryx australis*) hides itself among the roots of large trees during the day, and sallies forth in search of food at night. It feeds on insects, worms and seeds. Although it has no wings, their absence is compensated for by the bird's great swiftness of foot. The few known species of *Apteryx* are very similar, and are all found in New Zealand. They are comparatively small birds, hardly reaching two feet in height.

Order VIII. **Grallatores.** (Wading Birds.)

In these birds, the beak is generally longer than the head, the neck is long and slender, and the wings and power of flight are well developed. The legs are very long, and are generally feathered only to half the length of the tibia. The toes are long, and are either free, or connected together by a web. The birds are generally seen on the banks of rivers, or in swamps and marshes, where they feed on worms and insects, and on various small animals which they find in the water.

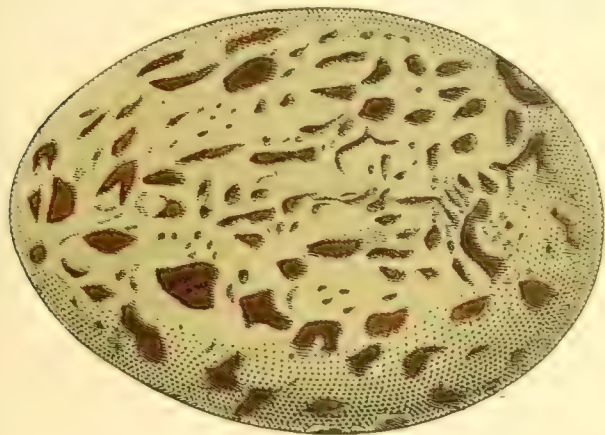
Family I. **Otidæ.** (Bustards.)

(Plate XXIV.)

The Bustards have a conical beak like a fowl, very strong legs, and only the three front toes, which are very broad. They have large wings and a short broad tail composed of twenty feathers. The birds are shy, but do not fly well, as their bodies are rather bulky.

Fig. a. The Great Bustard (*Otis tarda*) is a magnificent bird, and the male attains the size of a

large turkey-cock. He has a movable beard hanging down from the corners of his beak, which consists of two rows of pale grey feathers. The head and neck are light grey, the upper part of the body is rusty yellow with brownish black transverse bands,



Egg of Great Bustard.

and the belly is white. The tail, which is composed of twenty feathers, is mostly white, and can be spread out like a fan. The Great Bustard inhabits the plains of Central and Southern Europe, but is now extinct in England.

Family II. *Ardeidae*. (Hérons.)

(Plate XXV.)

The Herons have a long hard pointed beak, which is sometimes spoon-shaped, or otherwise of unusual form; a long neck, long slender legs, and powerful wings. They feed on fish, amphibia, and reptiles, and generally make their nests on trees.

In the genus *Ciconia* the front of the head is flat, the long straight beak sharply pointed, the skin of the throat naked and extensile, and the legs very long, with short toes connected by a small web. The wings are large and broad, and the tail, which is composed of twelve feathers, is short and rounded. They make their nests either on high trees, or on houses.

Fig. b. The Stork (*Ciconia alba*) is white, with black wings, and red beak and legs. It builds its nest on church towers and other buildings, often in large towns. It is a favourite with country people, too, for it destroys large numbers of frogs, snakes, and mice. During flight, it stretches out its neck and legs horizontally. It is a migratory bird in Central Europe, which it quits for warmer climates in August, but returns to its old nest in March.

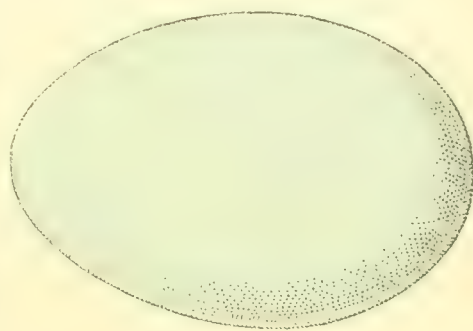
Fig. c. The Black Stork (*Ciconia nigra*) is brownish black with a metallic lustre; the breast, belly and thighs are white. The feet and beak are green in the young bird, and afterwards turn red. Contrary to the habit of the White Stork, it shuns the abodes of man, and lives in flat wooded districts near lakes and rivers, and makes its nest in large and thick forest trees. It is much scarcer in Europe than the White Stork.

Fig. d. The Marabou Stork (*Leptoptilus crumenifer*) of Africa, and the closely-allied Indian Adjutant (*L. dubius*) are much larger than the European Storks, and are remarkable for the nearly naked head and neck, only covered with a scanty down, and for the singular excrescence on the neck.

The true Herons have a long compressed and pointed beak, the slender neck is generally clothed

with very short feathers; and there are twelve feathers in the tail.

Fig. e. The Heron (*Ardea cinerea*) is ashy grey above and white below, and is ornamented with large tufts of feathers on the back of the head and under the throat. Herons frequent the banks of rivers and lakes, where they feed on fish. But they are ravenous birds, and will also devour frogs, water-



Egg of Heron.

insects, field-mice, or any other small animals which chance to come in their way. The Herons generally make their nests in colonies on large trees. Such colonies are called heronries. The heron is very shy and wary. In flying it bends its head and neck over its back, and stretches out its legs horizontally.

Fig. f. The Purple Heron (*Ardea purpurea*) is dark ashy-grey, varied with rusty brown above, and pure rusty-red beneath; the top of the head is black. It inhabits Southern and South-Eastern Europe from April to September.

(Plate XXVI.)

Fig. a. The Night Heron (*Nycticorax europæus*) has grey wings, a white neck and belly, and a black head and neck. The head is adorned with three long narrow feathers. It is a common bird in the warmer parts of the Northern Hemisphere, but becomes scarce in Central Europe. It builds its nest in low trees and bushes.

Fig. b. The Little Bittern (*Ardetta minuta*) is a native of South-Eastern Europe. The full-grown male has the neck, throat, and wing-feathers of a bright rusty-yellow; the belly is yellowish white with brown streaks, and the head, back and tail are black.



Egg of Little Bittern.

Fig. c. The Bittern (*Botaurus stellaris*) is not rare in many parts of Europe, but hides itself in thick swamps, among reeds and rushes. It is not much bigger than a raven in reality, but its loose feathers make it look much larger. It is rusty-yellow with brownish black spots, the head is brownish black, and the throat white. The cry of the male sounds like the bellowing of an ox.

In the Cranes the beak is of moderate length, and straight, somewhat like that of a common fowl; the neck is slender, the legs strong and very long, and the small hind-toe placed high. The wings are large and broad, and the tail, which is composed of twelve feathers, is short and rounded.

Fig. d. The Crane (*Grus cinerea*) is ashy grey, with a bare crescent-shaped red spot at the back of the head. The three hinder wing-feathers are sickle-shaped and flossy. It is rather larger than the stork. The Crane is found in the greater part of the Old World, except the extreme North, and is a summer visitor in Europe. It frequents both marshes and meadows.

In the Ibises the face and chin are naked, the long sickle-shaped beak is curved downwards; the upper mandible bears a furrow from the nostrils to the tip, and the lower jaw is furrowed for half its length. The legs are bare far above the feet, and the wings are large and broad. They live in warm countries, and frequent the banks of rivers, and lakes and marshes.

Fig. e. The Sacred Ibis (*Ibis religiosa*) is a bird of historic interest. It was highly venerated by the ancient Egyptians, perhaps partly on account of the service which it renders in destroying frogs, small snakes &c. after the inundations of the Nile. The beak, the naked part of the head and neck, the wing-plumes, the tail and the legs are black, and the rest of the body white. It is about the size of a common fowl, if the long legs are left out of consideration.

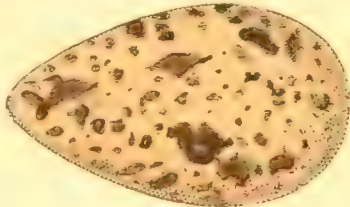
Family III. Charadriidæ. (Lapwings.)

(Plate XXVI.)

The legs are long and slender, and the hind toe is rudimentary. The birds frequent sandy shores, and live on molluscs, worms and insects.

In the genus *Vanellus* the hind toe is small, but fully developed, and the head is either tufted, or has bare folds of skin on the sides.

Fig. h. The Lapwing (*Vanellus cristatus*) is about as large as a pigeon, and the back of its head is ornamented with a tuft of narrow feathers. The back is metallic green with a purple lustre, the throat and breast are black, the belly white, and the legs red. It is very common in many parts of Europe.

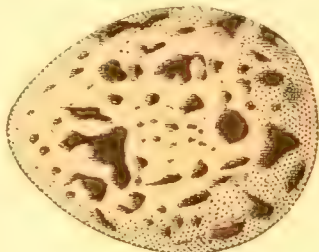


Egg of Lapwing.

Family IV. Scolopacidæ. (Snipes.)

(Plate XXVI.)

The head is laterally compressed, the forehead high and long, and the eyes placed rather high and back. The beak is extremely long and narrow, with a soft tip, serving as an organ of taste. The legs are comparatively short, the wings broad, and moderately long, and the tail short and broad. The females are generally rather larger than the males. The birds are fond of damp woods and marshy



Egg of Woodcock.

places, where they feed on worms and insects. They are found in northern countries, and migrate southwards in autumn.

Fig. f. The Woodcock (*Scolopax rusticola*) has an inconspicuous greyish-brown plumage, which renders the bird difficult to see upon the ground. It is generally a migratory bird in Central Europe.

Fig. g. The Common Snipe (*Scolopax gallinago*) is about the size of a blackbird, and its beak is flattened at the tip. All the Snipes have very similar habits, and are much sought after by sportsmen.

(Plate XXVII.)

Fig. a. The Ruff (*Macetes pugnax*) belongs to the Snipes, as is shown by its soft beak, which is obtusely rounded in front. The male is one-third larger than the female, which is called a Reeve; and in spring he is adorned with a large collar of stiff feathers, and with small yellow warts on the face. At this time, the males, like many other birds during the pairing season, fight together furiously.

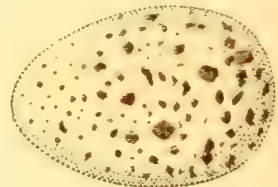
Family V. Fulicidæ. (Water Hens.)

(Plate XXVII.)

The birds of this family have short legs and beak, slightly developed wings, and large legs like those of fowls. The strong toes are often very long, and in some species are entirely surrounded with folds of skin, which enables them both to swim well, and to run easily and rapidly over the water-plants in the swamps and marshes which they inhabit.

Fig. b. The Water Hen (*Gallinula chloropus*) is very common in the neighbourhood of streams and ponds in many parts of Europe. The back is olive-grey, and the belly slate-colour; there is a red protuberance on the forehead, and the legs are green.

Fig. c. The Corncrake (*Ortygometra crex*) is met with in large meadows and fields, where the harsh cry of the male is to be heard everywhere in summer-time. It is common throughout Central Europe and Asia.



Egg of Corncrake

In the genus *Parra* the beak is long and slender, and the legs are also very long. The toes are slender, and the claws extremely long; the wings are narrow and pointed, and the tail is short. They inhabit tropical countries and walk about over the large-leaved plants which grow there in the marshes.

Fig. d. The Jacana (*Parra Jacana*) is common in the swamps of South America wherever water-lilies grow. Our figure represents the bird of about two-thirds of the natural size.

Order IX. Palmipedes. (Swimming Birds.)

These birds are distinguished from all others by a thick stiff plumage, which is constantly lubricated with oil from the well-developed oil-gland, and the body is thus kept raised above the water. The beak is either flattened, or convex, and generally toothed, in order to hold the water-animals on which these birds feed. The power of flight is better developed in some of these birds than others, but the legs show more resemblance than the wings, always being feathered to the shank, and either wholly or partly webbed between the toes.

Section I. Gavie.

Family I. Laridæ. (Sea-Gulls.)

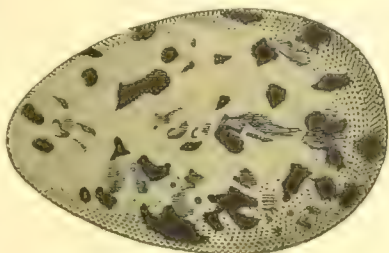
(Plate XXVII.)

The Gulls, Petrels and Albatrosses have pointed wings, and rarely come to land except to breed.

In the Gulls, the beak is compressed, and larger in some species than in others, the legs are furnished with three webbed toes, and a hinder toe. They feed on fish, which they pounce upon in the water.

They live in large flocks, and are most numerous in the Northern seas.

Fig. c. The Black-headed Gull (*Larus ridibundus*) is about as large as a pigeon. It is one of the commonest species, and is found on the coasts and inland seas of all Europe, and of a great part of Asia and Africa. The head is brown in summer and white in winter, the back ashy grey, the tips of the wings black and the rest of the body snow-white. The beak and legs are blood-red.



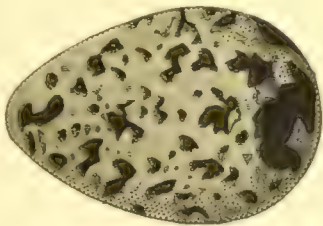
Egg of Black-headed Gull.

Fig. f. The Great Black-backed Gull (*Larus marinus*) is found in northern and central Europe. It is nearly as large as a goose, and is a bold and voracious bird which will even rob other sea-birds of their prey. It is an excellent flyer and swimmer, and does not shun the most tempestuous waters.

Fig. g. The Herring Gull (*Larus argentatus*) which is the size of a raven, is also met with on the coasts of the northern seas, and is sometimes seen about inland lakes. Its plumage is pure white, except the two first wing-feathers and the tips of the others, which are black.

(Plate XXVIII.)

Fig. a. The Common Tern (*Sterna hirundo*) is smaller than the true Sea-Gulls and has a forked tail, long pointed wings and a very swift flight, and is therefore often called the sea-swallow. The three front toes are connected by short webs, and the hinder toe, which is smaller and placed rather higher, is free. It is common on the coasts of Europe as well as on large lakes and rivers. It makes its nest in hollows on shingle, and feeds on fish and other aquatic animals.



Egg of Common Tern.

Fig. b. The Pomarine Skua (*Lestris pomarina*) differs from the Tern in the form of the beak, which is strongly hooked at the tip. The lower mandible is provided with a projecting notch. The wings are long and pointed, the tail rounded, and the claws sharp and very strongly curved. These birds do not dive so well as the true gulls, which they rob of their prey during flight, and they also feed on the eggs and young of other birds. The present species is a dark greyish-brown bird as large as a raven. It inhabits the northern seas.

Family II. Procellariidæ. (Petrels and Albatrosses.)

(Plate XXVIII.)

These birds are characterised by the absence of the hinder toe and by the form of the nostrils, which rise in a double tube on the back of the beak. These birds resemble the sea-gulls in their form and habits, but prefer the open sea.

In the Petrels (*Thalassidroma*) the small beak is hooked at the tip, the nostrils form a divided tube and the hinder toe is but slightly developed.

Fig. c. The Stormy Petrel (*Thalassidroma pelagica*) is about six inches long and is of a sooty-black colour, with a white rump and a white trans-

verse stripe on the wings. It is constantly on the wing, and is met with on the open ocean between Europe and America. Sailors usually regard it as a signal of bad weather, for it is often seen during storms, half flying and half running over the waves in pursuit of fish, Medusæ and other small animals.

In the Albatrosses (*Diomedea*) the beak is long, straight and sharp, the nostrils form separate tubes, the wings are very long and narrow, and the tail is rounded.

Fig. d. The Albatross (*Diomedea exulans*) is a majestic bird, measuring over four feet in length, and twelve feet in expanse of wing. It is found in all seas, and makes its nest on the most lonely islands. It feeds on fish, molluscs and carrion.

Section II. Steganopodes.

In these birds the feet are webbed and very large. The beak is straight and slender, and is generally very long, like the neck. Some species have an enlarged crop or a bag-like skin on the lower jaw. Their wings are long and pointed and adapted for swift and well-sustained flight.

In the genus *Pelecanus* the beak is very broad and long, and the two bony supports of the lower jaw are connected by a broad expansible throat-pouch.

Fig. e. The Pelican (*Pelecanus onocrotalus*) is a native of South Eastern Europe and the adjacent parts of Asia and Africa. It frequents shallow bays and large lakes and makes its nest among reeds in inaccessible places. It feeds on fish, which are usually stored in the throat-pouch before being swallowed. Although this large bird weighs from 20 to 25 pounds, it has a high and rapid flight, and is also an excellent swimmer and diver.

Section III. Anseres.

(Plate XXV.)

These birds are characterised by the form of the beak which is usually broad and flat (rarely narrow), with the tip curved and the sides covered with a soft skin, which is transversely wrinkled. The edges of the beak are toothed in transverse layers, and form a kind of sieve with the tongue which is dentated at the edge. The feet are provided with three webbed toes in front, and a rudimentary hind toe. The plumage is generally soft and glossy, and the flesh excellent, although most other waterbirds have a strong fishy taste, which renders them unfit for food.

In the genus *Phoenicopterus* the beak is abruptly curved, and the neck and legs very slender. They inhabit the warmer parts of the world.

Fig. a. The Flamingo (*Phoenicopterus roscus*) is a beautiful bird, especially when fullgrown. The plumage is white, suffused with rose-red, and the wings are bright red. They are fond of brackish water and especially lagunes. They fly and swim well, and when seeking for food, turn their heads so far round that the upper mandible is often undermost.

In the Swans (*Cygnus*) the neck is long and slender, the beak is equally broad throughout, and there is a broad bare space between the beak and the eyes. The legs are short and placed far back, and therefore these birds walk clumsily, but they swim very gracefully, and their flight is strong.

(Plate XXVIII.)

Fig. f. The Mute Swan (*Cygnus olor*) is a native of Northern Europe, but is now seen in a semi-domesticated state on all rivers and ornamental waters. It is a very fine bird, measuring nearly five feet in length, and weighing over twenty pounds. Its plumage is pure white, the beak bright red, the nostrils, the lower part of the beak, the protuberances before the forehead, and the legs are black.

Fig. g. The Wild Swan (*Cygnus musicus*) resembles the last species in size and form, but the beak is yellow, without protuberances, and the bare space between the beak and eyes is also yellow. It is sometimes called the Whistling Swan on account of the noise produced by the wings during flight, and the trumpet-like tone emitted from the wind-pipe, which forms several convolutions behind the breastbone. It is a native of the North of Europe, and migrates southwards during the winter.

In the Geese (*Anser*) the beak is higher than broad, and ends above and below in a convex point with sharp edges. The neck is moderately long and slender, the plumage soft and the legs strong. They migrate southwards during severe weather.

Fig. h. The Grey Goose (*Anser cinereus*) is considered to be the wild species from which our domestic goose is derived. The beak is orange, the naked eyelids and the legs flesh-coloured, and the plumage always grey, with the back brown, varied with pale grey. It inhabits the temperate parts of Europe and Asia.

(Plate XXIX.)

Fig. a. The Bean Goose (*Anser segetum*) has a black beak, orange-coloured in the middle, and long wings, extending beyond the tip of the tail. It is found in the north of Europe, Asia and North America, and migrates to the south in vast flocks on the approach of cold weather.

Fig. b. The Brent Goose (*Branta bernicla*) is as large as a common duck. It prefers the neighbourhood of the sea, and only visits fresh water during its migrations. The legs are longer than in the other geese, and the plumage is dark ashy grey, with the exception of the white belly, and a white crescent-shaped mark on each side of the neck; the head, neck and throat are black.

In the Ducks (*Anas*) the beak is broad and notched, the wings of moderate size, the tail short and rounded, and the legs placed far backward, which makes their gait clumsy and waddling, though they swim, dive, and fly well. They are much valued for their flesh and feathers.

Fig. c. The Eider Duck (*Somateria mollissima*) has the softest plumage of all, and the elastic down is much used for bedding. The full-grown male (fig. c, a) is white and black, in large masses of colour, but the female (fig. c, b) is dark brownish black. It is almost exclusively confined to the extreme north of Europe, Asia, and North America, and is only found on the shores of the sea.

Fig. d. The Harlequin Duck (*Fuligula histrionica*) is very beautifully coloured. The male is violet-black, spotted with white, and has two white bands on the neck, while the female is of a rusty red. It is found in many parts of the northern hemisphere.

Fig. e. The Velvet Scoter (*Oidemia fusca*) is also an inhabitant of the circumpolar regions, but migrates southwards in winter, as far as the Swiss lakes. Its plumage is plainly coloured, but is almost as soft and valuable as eider-down.

Fig. f. The Wild Duck (*Anas boschas*) resembles the tame duck in form and colour, but is smaller and more slender. The male assumes his finest plumage between November and May. The head and neck are greenish-black with a metallic lustre, the breast, belly and thighs are light grey, the upper part of the back dark brown, and the wings grey, marked with bright blue. The female is of a rusty yellowish-brown colour, with blackish-brown spots, and likewise exhibits the blue mark on the wings. The wild duck is a shy and wary bird.

Fig. g. The Common Sheldrake (*Tadorna vulpanser*) is larger than the tame duck and has rather longer legs. In the male the head and neck are shining black, with a large mark on the wings which is green in front and rusty-red behind; the beak is red, the legs flesh-coloured and the greater part of the rest of the body is brown and black above, and white beneath. The female is similarly coloured but duller. It frequents the sea-coasts in the temperate parts of Europe and Asia, and generally makes its nest in burrows in the ground, sometimes utilizing those of the fox and badger.

Fig. h. The Pintail Duck (*Anas acuta*) is frequently seen on ornamental waters. The male in full plumage is black and white above, and white beneath, the head is dark brown, the mark on the wings coppery-red, bordered by rusty red bands, and the middle tail-feathers are black and very long. The female is smaller and inconspicuously coloured. This bird inhabits the northern parts of Europe, Asia and America, but also breeds in Central Europe.

(Plate XXX.)

In the genus *Mergus* the beak is very narrow and raised; it is hooked, and furnished with sharp notches on the edges. These birds inhabit the northern parts of both hemispheres, but migrate southwards in winter.

Fig. a. The Goosander (*Mergus merganser*) is an excellent swimmer and diver. The male in full plumage has the head, the upper part of the neck, and the shoulders black with a green metallic lustre, and a bushy crest of the same colour on the head. The mark on the wings is white, and the rest of the body is white, slightly suffused with reddish yellow.

Section IV. *Impennes.*

In this section the wings are short, and the legs are placed so far back that the birds can only walk with difficulty, and with the body in an upright position.

Family I. *Colymbidæ.* (Divers).

The Divers are better fitted for swimming and diving than for walking and flying. The hard beak is generally provided with contractile nostrils, the body is clothed with compact feathers, the short legs are placed far back, and the tail is short or absent. They inhabit the northern and temperate zones, and are almost always found on the water, where they breed in a floating nest.

Fig. b. The Great Crested Grebe (*Podiceps cristatus*) is as large as a wild duck. The male is blackish-brown above and shining white beneath, and is adorned with a black crest of feathers on the head, and a rusty-red collar on the neck, bordered with black. It is found on the sea-coasts of Europe, Asia, North Africa and North America.

Fig. c. The Great Northern Diver (*Colymbus glacialis*) is quite as large as a goose, and weighs

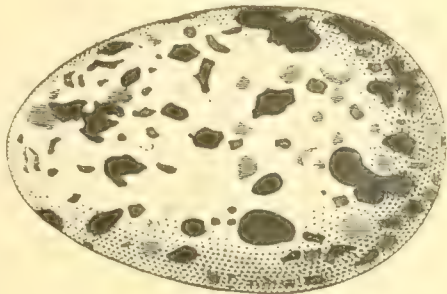
twelve pounds. It is found on the sea-coasts of the extreme North.

Family II. *Alcidæ*. (Auks.)

The wings are short and most often useless for flight, but are fully provided with feathers. The legs are placed far back, the three front toes are fully webbed, and the hind toe is completely absent. The short beak is generally narrow and laterally compressed. The birds live in flocks in the north polar seas, and are useful to the inhabitants of those inclement regions for their eggs and oil.

In the genus *Uria* the head is small, the neck thick, the body oval, the beak moderately long and tapering to a point, the wings small, and the tail short and rounded, and composed of twelve feathers. They dive well, fly heavily, and live in pairs in the bird-colonies of the northern seas.

Fig. d. The Black Guillemot (*Uria grylle*) is very common in the northern seas. These birds live in pairs, and are very much attached to one another.



Egg of Black Guillemot.

In the genus *Alca* the beak is very high and narrow, with transverse furrows on the sides, and a small protuberance at the base of the upper mandible. The short legs are concealed beneath the skin of the belly almost to the feet, the wings are small and narrow, and the short tail is conical.

Fig. e. The Great Auk (*Alca impennis*) is

rather smaller than a goose. It is black above, with the exception of a white oval spot near the eye, and is white beneath. It formerly inhabited the rocky coasts of the extreme north, and though incapable of flight, used to climb about with great activity. It is now believed to be extinct.

In the genus *Fratercula* the beak is smooth and furrowed in front, and when seen from the side appears triangular, being very high and narrow. There is a soft, elastic space of skin at the angle of the mouth. The legs are short, with three completely webbed toes; the wings are small and narrow, but adapted for swift whirring flight; and the tail is short and narrow, and composed of sixteen feathers.

Fig. f. The Puffin (*Fratercula arctica*) is another bird, which makes its nest on small islands and rocky places in the northern seas in immense flocks.

In the genus *Aptenodytes* and its allies the head is small, and the beak is long with sharp edges, and is compressed at the sides and curved in front. The slender neck is placed on an almost cylindrical body which is clothed with thick, smooth feathers, and is supported in a completely upright position by short webbed feet, which are provided with three front toes and a free hind toe, which is rudimentary and curved forwards. However, the most characteristic feature in the penguins is to be found in the long, narrow wing-flaps, which are only clothed with short, scale-like feathers, and are quite useless for flight. The Penguins inhabit the colder seas and coasts of the southern hemisphere, swim and dive well, and the females incubate their eggs between their thighs.

Fig. g. The Patagonian Penguin (*Aptenodytes patagonica*) is entirely black above, except two white spots over the eyes; the lower part of the body is white. The beak is transversely furrowed. It inhabits the most southerly parts of South America.

Accipitres. Vultures and Secretary Bird.



a) Egyptian Vulture.
N. thron perenopterus.

b) Griffin Vulture.
Gyps fulvus.

c) Condor.
Sarcorhamphus gryphus.

d) Bearded Vulture.
Gypaëtus barbatus.

e) Secretary Bird.
Serpentarius secretarius.



a) Golden Eagle.
Aquila chrysaetos.

b) White-tailed Eagle.
Haliaeetus albicilla.

c) Serpent Eagle.
Circaetus gallicus.

d) Kite.
Milvus rufus.





a) Montagu's Harrier.
Circus pygargus.

b) Buzzard.
Buteo vulgaris.

c) Osprey.
Pandion Haliaeetus.

d) Jerfalcon.
Microfalco candicans.

e) Goshawk.
Astur palumbarius.



a) Peregrine Falcon.
Falco peregrinus.

b) Hobby.
Falco subbuteo.

c) Kestrel.
Falco tinnunculus.

d) Sparrow-Hawk.
Accipiter Nisus.

e) Chanting Falcon.
Melierax musicus.



a) Eagle Owl.
Bubo maximus.

b) Eared Owl.
Otus vulgaris.

c) Brown Owl.
Uta aluco.

d) Barn Owl.
Strix flammea

e) Little Owl.
Athene noctua.



a) Great Grey Shrike.
Lanius excubitor.

b) Red-backed Shrike.
Lanius collurio

c) Lesser Grey Shrike.
Lanius minor.

d) Great Scarlet Macaw.
Ara macao.

e) Alexandrine Parakeet.
Palaeornis Alexandri.

f) Sir Joseph Banks' Cockatoo.
Calyptorhynchus Banksii.



a) Grey Parrot. *Psittacus erithacus.* b) Yellow-crested Cockatoo. *Cacatua galerita.* c) Ariel Toucan. *Rhamphastos ariel.* d) Black Woodpecker. *Dryocopus martius.* e) Green Woodpecker. *Gecinus viridis.* f) Great Spotted Woodpecker. *Picus major.* g) Lesser Spotted Woodpecker. *Picus minor.*





a) Middle Spotted Woodpecker.
Picus medius.

b) Wryneck.
Yunx torquilla.

c) Nuthatch.
Sitta europaea.

d) Kingfisher.
Alcedo hispidus.

e) Bee Eater.
Merops apiaster.

f) Hoopoe.
Upupa epops.



a) Tree Creeper.
Certhia familiaris.

b) Little Humming-Bird.
Misuga minima.

c) Tufted Coquette.
Lophornis ornatus.

d) Lazuline Sabre-wing.
Campylopterus lazulus.

e) Raven.
Corvus corax.

f) Rook.
Corvus frugilegus.

g) Carrion Crow.
Corvus corone.



a) Hooded Crow.
Corvus cornix.

b) Jackdaw.
Corvus monedula.

c) Jay.
Garrulus glandarius.

d) Nutcracker.
Nucifraga caryocatactes.

e) Alpine Chough.
Pyrrhocorax alpinus.

f) Chough.
Fregilus graculus.

g) Magpie.
Pica caudata.





a) Roller Bird.
Coracias garrula.

b) Great Bird of Paradise.
Paradisaea apoda.

c) Cock of the Rock.
Rupicola crocea.

d) Golden Oriole.
Oriolus galbula.

e) Crow Blackbird.
Quiscalus versicolor.

f) Hill Myna.
Gracula religiosa.

g) Cuckoo.
Cuculus canorus.



a) Skylark.
Alauda arvensis.

b) Woodlark.
Alauda arborea.

c) Crested Lark.
Alauda cristata.

d) Starling.
Sturnus vulgaris.

e) Dipper.
Cinclus aquaticus.

f) Song Thrush.
Turdus musicus.



a) Missel Thrush.
Turdus viscivorus.

b) Fieldfare.
Turdus pilaris.

c) Ring Ouzel.
Turdus torquatus.

d) Blue Thrush.
Turdus cyaneus.

e) Blackbird.
Turdus merula.

f) Bohemian Wax-wing.
Ampelis garrula.



a) Cross-bill.
Loxia curvirostris.

b) Pine Grosbeak.
Pyrrhula enucleator.

c) Bullfinch.
Pyrrhula vulgaris.

d) Greenfinch.
Coccothraustes chloris.

e) Hawfinch.
Coccothraustes vulgaris.

f) Yellow Hammer.
Emberiza citrinella.

g) Ortolan.
Emberiza hortulana.





a) Girl Bunting.
Emberiza cirius.

b) Snow Bunting.
Plectrophanes nivalis.

c) House Sparrow.
Passer domesticus.

d) Chaffinch.
Fringilla coelebs.

e) Mountain Finch.
Fringilla montifringilla.

f) Snow Finch.
Montifringilla nivalis



a) Goldfinch.
Fringilla carduelis.

b) Canary.
Serinus canarius, var.

c) Linnet.
Fringilla cannabina.

d) Siskin.
Pinicola enervator.

e) Citril Finch.
Fringilla citrinella.

f) Common Bunting.
Emberiza miliaria.





a) Nightingale.
Daulias luscini

b) Blue-throated Warbler.
Cyanecula cyoica.

c) Blackcap.
Sylvia atricilla.

d) White-throat.
Sylvia cinerea.

e) Garden Warbler.
Sylvia hortensis.

f) Snow White-throat.
Sylvia curruca.

g) Icterine Warbler.



a) Robin.
Erythra rubecula.

b) Golden-crested Wren.
Regulus cristatus.

c) Wren.
Troglodytes vulgaris.

d) Redstart.
Phoenicurus ruticilla.

e) Great Reed-Warbler.
Acrocephalus arundinaceus.

f) Whinchat.
Pratincola rubetra.

g) White Wagtail.
Motacilla alba.

h) Yellow Wagtail.
Motacilla flava.



a) Great Titmouse.
Parus major.

b) Blue Titmouse.
Parus caeruleus.

c) Cole Titmouse.
Parus ater.

d) Crested Titmouse.
Parus cristatus.

a) Chimney Swallow.
Hirundo rustica.

b) House Martin.
Chelidon urbica.

c) Sand Martin.
Cotile riparia.

d) Goatsucker.
Caprimulgus europaeus.

e) Marsh Titmouse.
Parus palustris.



a) Rock Dove.
Columba livia.

b) Trumpeter.

c) Tumbler.

d) Tern Pigeon.

e) Fan-tail.

f) Nicobar Pigeon.
Columba nicobarica





a) Stock Dove.
Columba oenas.

b) Pouter Pigeon.
Columba livia, var.

c) Passenger Pigeon.
Ecopistes migratorius.

d) Laughing Pigeon.
Columba risoria.

e) Turtle Dove.
Turtur vulgaris.

f) Crowned Pigeon.
Goura coronata.

g) Quail.
Coturnix communis.



a) Ptarmigan.
Lagopus mutus.

b) Black Grouse.
Tetrao tetrix.

c) Capercaillie.
Tetrao urogallus.

d) Partridge.
Perdix cinerea.

e) Red-legged Partridge.
Caccabis rubra.

f) Greek Partridge.
Caccabis saxatilis.

g) Guinea-fowl.
Numida meleagris.

h) Cock.
Gallus bankiva, var.



a) Silver Pheasant.
Euplocamus nychthemerus.

b) Golden Pheasant.
Thaumalea picta.

c) Argus Pheasant.
Argus giganteus.

d) Peacock.
Pavo cristatus.

e) Impeyan Pheasant.
Lophophorus impeyanus.

f) Turkey.
Meleagris gallopavo.



a) Great Bustard.
Otis tarda.

b) Cassowary.
Casuarius galeatus.

c) Ostrich.
Struthio camelus.

d) Rhea.
Rhea americana.



a) Flamingo.
Phoenicopterus roseus.

b) White Stork.
Ciconia alba.

c) Black Stork.
Ciconia nigra.

d) Marabou Stork.
Leptoptilus crumenifer.

e) Heron.
Ardea cinerea.

f) Purple Heron.
Ardea purpurea.



a) Night Heron.
Nycticorax europaeus

b) Little Bittern.
Ardetta minuta.

c) Bittern
Botaurus stellaris.

d) Crane.
Grus cinerea.

e) Sacred Ibis.
Ibis religiosa.

f) Woodcock.
Scolopax rusticola.

g) Common Snipe.
Scolopax gallinago.

h) Lapwing.
Vanellus cristatus



a) Ruff.
Machetes pugnax.

b) Water Hen.
Gallinula chloropus.

c) Corncrake.
Ortygometra crex.

d) Jacana.
Parra jacana.

e) Black-headed Gull.
Larus ridibundus.

f) Great Black-backed Gull.
Larus marinus.

g) Herring Gull.
Larus argentatus.



a) Common Tern.
Sterna hirundo.

b) Pomarine Skua.
Lestrnis pomarina.

c) Stormy Petrel.
Thalassidroma pelagica.

d) Albatross.
Diomedea exulans.

e) Pelican.
Pelecanus onocrotalus.

f) Mute Swan.
Cygnus olor.

g) Wild Swan.
Cygnus musicus

h) Grey Goose.
Anser cinereus



a) Bean Goose. *Anser segetum*.
 b) Brent Goose. *Brenta bernicla*.
 c) Fider Duck. *Somateria mollissima*.
 a. Male. b. Female.
 d) Harlequin Duck. *Fuligula histrionica*.
 e) Velvet Scoter. *Oidemia fusca*.
 f) Wild Duck. *Anas boschas*.
 g) Common Shieldrake. *Tadornia vulpanser*.
 h) Pintail Duck. *Anas acuta*.



a) Goosander.
Mergus merganser

b) Great Crested Grebe.
Podiceps cristatus

c) Great Northern Diver.
Colymbus glacialis.

d) Black Guillemot.
Uria gryll

e) Great Ank.
Alca impennis.

f) Puffin.
Fratercula arctica

g) Patagonian Penguin.
Aptenodytes patagonicus

Reptiles (Reptilia).

INTRODUCTION.



THE REPTILES form the third Class of Vertebrated Animals. Whilst Mammals and Birds present such well-marked characteristics that anyone would recognize a mammal or bird at once, this is not so easy in the small class of Reptiles, and it needed the penetration of true naturalists to arrange animals so different in shape and size in one Class. Of course this classification was not founded upon the external appearance of the animals but upon the characters of the internal organs. Thus all reptiles, whatever their form, are cold-blooded vertebrates, with lungs, but with the large and small circulatory systems imperfectly separated.

The Reptiles used formerly to be placed in one class with the Amphibia, partly on account of the similarity of their external appearance, and partly on account of their structure, although the latter is really very different. The skeleton shows transitions from a simple cartilaginous spinal column without ribs or limbs, to a complete bony vertebrate column with a larger or smaller number of long ribs, and strong and long extremities. The Reptiles, comprising the Tortoises, Lizards, and Snakes, have only one articulation connecting the head with the first vertebra, but the Amphibia have two.

The form of the body differs remarkably in different species. We meet with gradations from the long cylindrical Snakes, without, or with only rudimentary limbs, to the broad flattened bodies and well-developed limbs of the Tortoises.

Equally varied are the appendages of the skin. The Lizards and Snakes are clothed with scales, but

tortoises are encased in a coat of mail formed of plates of bone connected with the skeleton itself.

The brain is small in comparison to the size of the body and of the spinal cord, and therefore the intelligence is rather limited, but the eyes, ears, and sense of smell are fairly well developed in most reptiles, though not always equally. Respiration is effected in all reptiles by means of large-celled lungs, in which the blood comes into far less complete contact with the air than in the case of mammals and birds. This is the cause of the lower temperature of their blood, which only rises a few degrees above that of the surrounding medium. It also explains the comparative sluggishness or muscular inactivity of the whole Class.

The heart consists of two separate auricles, with thin walls, and two larger ventricles, which are usually imperfectly separated.

Reptiles differ as much in their habits as in outward form. Some live partly on land and partly in the water, whilst others live always on the land. On the whole the benefits and injuries which man derives from reptiles are fairly balanced; on the one hand many injurious or unpleasant animals are destroyed by reptiles but on the other hand they include venomous snakes, boa constrictors, and crocodiles, which are themselves dangerous.

The Eggs are covered by a calcareous parchment-like shell, and are generally buried in the ground, and left to be hatched by its warmth. Some snakes brood over their eggs with their body until the young emerge. In many cases the young emerge from the eggs directly after they are laid; and a few reptiles are viviparous.

Reptiles are divided into four Orders:

Order I. Snakes. *Ophidia*. Body long and cylindrical without limbs.

„ II. Crocodiles. *Crocodylia*. Body covered with thick bony plates; toes clawed and webbed, and jaws provided with strong teeth.

„ III. Lizards. *Lacertilia*. Body covered with horny scales; limbs four, two, or absent; toes clawed; jaws provided with sharp teeth.

„ IV. Tortoises and Turtles. *Chelonia*. Body encased in a backplate (carapace) and a breastplate (plastron); limbs four. Teeth replaced by a sharp horny covering over the jaws, like the beak of a bird.

Order I. Ophidia. (Snakes.)

No animals are so much dreaded as the snakes, although we have only one venomous kind in England, the Common Viper, or Adder. All snakes have a long cylindrical body, with a well-marked flattened head, but generally with no distinct division between the body and the tail. They have no limbs, and it is only in a few species such as the Pythons, that on careful dissection, we meet with two small bones, which can be recognised as the rudiments of the hind limbs.

The so-called scales of snakes consist of a wrinkled-scales skin, and a delicate epidermis, covering the whole of it even to the eyes, and which is thrown off completely several times a year. The flattened head is interesting with its widely cleft mouth, movable upper jaw, and loosely connected lower jaw; an arrangement which enables the creature to swallow enormous mouthfuls. The teeth are curved backwards, and are only used for seizing prey, and are solid in harmless snakes, but have an outer groove in other species, or are perforated by a duct in venomous kinds, to convey the venom from the poison-gland. The forked tongue lies in a kind of sheath, and is a highly movable organ of touch, which to some extent replaces the deficiencies of the other senses. In spite of the absence of limbs, snakes move rapidly both on land and in the water, by rapid contractions of the vertebral column, and by supporting themselves with the free ends of the ribs; only a few species climb.

All snakes feed on living animals, which they kill either by crushing them, or by their bite; and after satisfying their hunger, they fall into a long torpor. Snakes inhabit the whole of the tropical and temperate zones but they are far more numerous in hot countries than in cold.

Section I. Non-venomous Snakes.

In these, all the teeth are equally developed; there are two parallel rows on each side in the upper jaw, and a close series of curved teeth in each division of the lower jaw.

In the *Boa* the head is triangular and flattened and the jaws open very widely and are armed with strong teeth. The head is covered with plates, and the throat with scales. There is a horny claw on each side of the base of the tail containing the rudiments of the hinder extremities. The Boas inhabit Asia, Africa and South America.

Plate I. fig. a. *Boa constrictor* inhabits tropical America and attains a length of twenty or thirty feet and the thickness of a stout man's thigh. The size and strength of the creature enable it to attack and destroy animals as large as a deer. It breaks the bones of its prey by coiling its gigantic body round it, and then slowly swallows it. After a meal the *Boa* sinks into a prolonged torpor, when it falls an easy victim to the natives, who value it for its flesh, and its thin variegated durable skin.

In the **Pythons** the head is well-marked, and covered with plates and there are teeth on the palate. There are two spurs at the base of the tail.

The **Rock Snake** (*Python molurus*) is found in most parts of India, and attains a length of ten or

eleven feet. The head is greyish flesh-colour, and the back is adorned with a row of large, irregular brown blotches, which are darker at the edges, and varied with deep yellow in the middle.

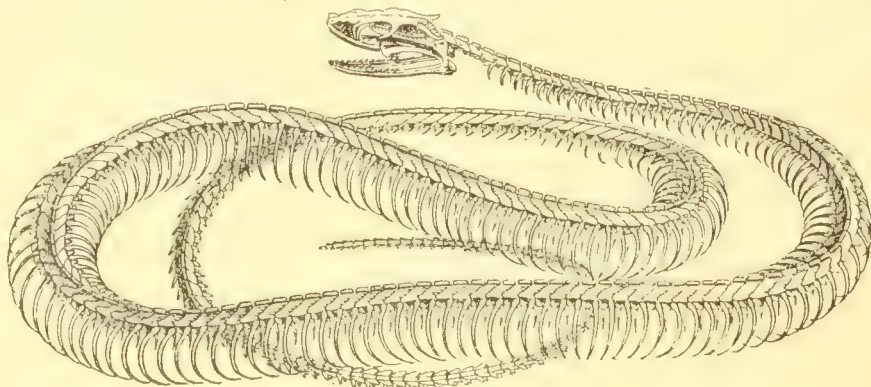
In the genus *Tropidonotus* the teeth are of nearly equal size. The eyes and nostrils are small and the pupil of the eye is round. The scales are ridged in the middle.

Plate II. fig. c. The **Common Snake** (*Tropidonotus natrix*) is frequently met with in England, and is quite harmless. It is easily recognized by its steel grey colour and the yellow blotches edged behind with black on each side of the neck. It sometimes attains the length of three or four feet. It is a good swimmer and diver and feeds on frogs, insects &c. Towards the end of the summer the female lays from twenty to thirty-six oval eggs in

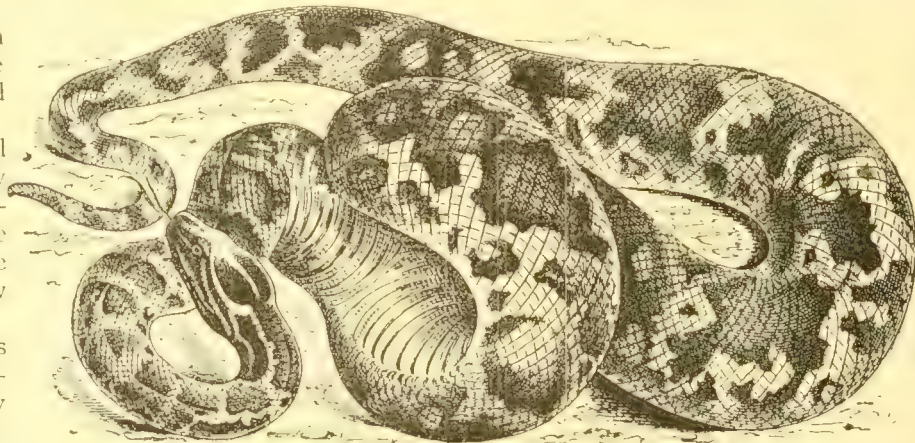
a dunghill or some other warm place. The common snake seldom bites, but defends itself by emitting a foul odour when alarmed.

Plate II. fig. d. *Coluber Aesculapii* was sacred to Aesculapius in ancient times. It is still common in Southern Europe and is as large or larger than our common snake. It is of a shining brownish grey with greenish shading marked with white on the sides, and with the belly sulphur yellow. (In this and the next species, the scales are smooth and unridged.)

Plate III. fig. b. *Coluber flavescens* is probably a variety of the last species, and may have been introduced into Germany by the Romans. It is found at Schlangenbad and Schwalbach in Nassau. It is brownish-grey above with two suffused yellow marks



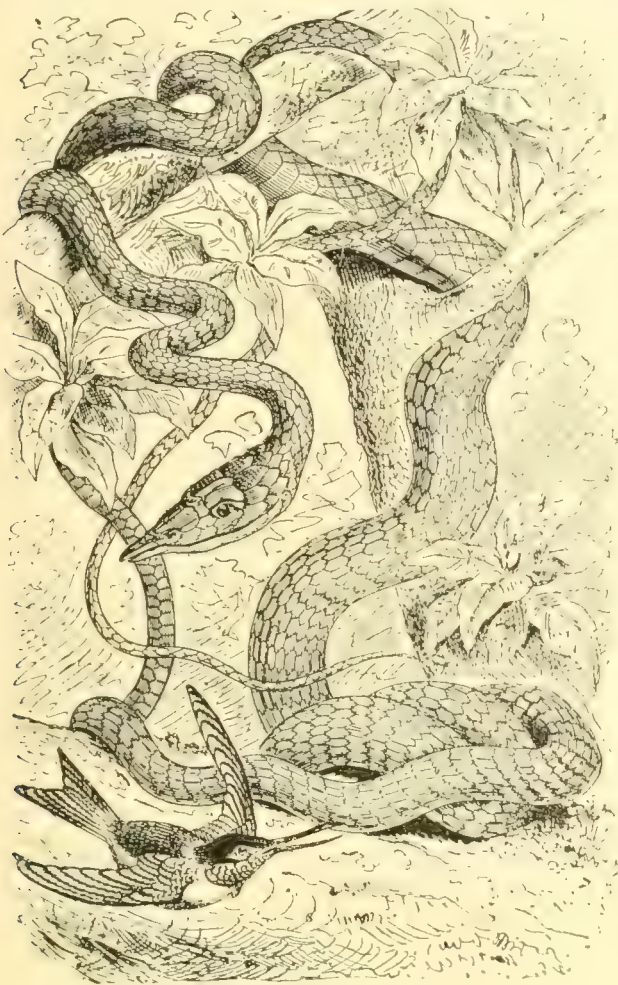
Skeleton of Snake.



Rock Snake (*Python molurus*).

on the back of the head, and the belly is cream-coloured. It feeds on mice and small birds, which it takes from the nest.

Plate III. fig. a. In *Coluber austriacus* the scales are not ridged. There is a large dark mark on the back of the head, and there are two rows of dark brown marks on the back. It is not unlike a viper in its general colour, but the absence of the zigzag



Whip-Snake (*Oxibelis fulgidus*).

mark; the broad scaly head and the much more slender form will at once distinguish it. It grows to the length of two or three feet, and inhabits south and east Germany in dry places. It lives on lizards and salamanders which it kills by constriction, like the boas.

The Whip-Snakes have a pointed muzzle and whip-like body. They are all beautifully coloured, and inhabit tropical countries. One of the prettiest species is

Oxibelis fulgidus, which is of a beautiful green with a pale longitudinal line, and measures about four feet in length. It lives in trees in South America and glides along with great swiftness.

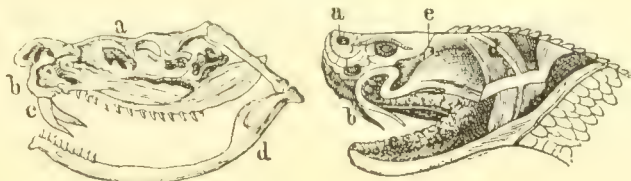
Section II. Venomous Snakes.

In the Sea-Snakes, the head is small and oval, and the body is thickest behind. They are very

venomous and are generally about four or five feet in length. They are found in the the Indian Ocean, and frequently enter the mouths of rivers. They are perfectly adapted to a aquatic life, for the tail is laterally compressed to form a rudder, and their nostrils can be closed by valves.

Plate III. fig. c. The Black-backed Sea-Snake (*Felamis bicolor*) is black and yellow. Its range extends to the coast of Tahiti, where it is a favourite dish with the natives.

The Rattlesnakes have very large poison-fangs, and there is a depression on each side of the face near the nostril. At the end of the tail is a loosely connected rattle consisting of horny rings which increase in number every year. The most representative species are all American.



Skull of Rattle-Snake.

Poison-Apparatus of Rattle-Snake

a) Brain-Cavity. b) Upper Jaw.
c) Poison-fang. d) Lower Jaw.

a) Nostril. b) Poison-fang. c) Salivary glands.
d) Temporal Muscle. e) Poison gland.

Plate I. fig. b. The Horrid Rattlesnake (*Crotalus horridus*) reaches the length of four feet, and is as thick as a man's arm. It is of a yellowish-white and brown colour, with black markings. Its bite is very deadly, but the snake itself is sluggish, and never attacks man without provocation. It feeds on small mammals and birds and is found throughout South and Central America, and in some parts of North America, where, however, the common rattlesnake (*C. durissus*) is more frequently met with.

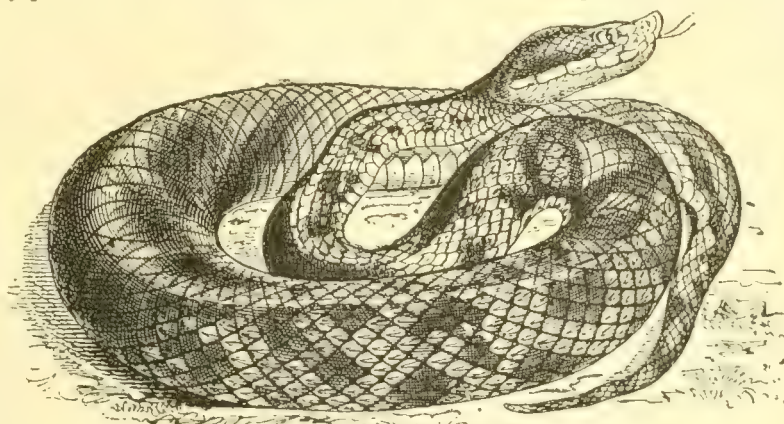
In the Cobras, the head is short and rounded, the poison-fangs short, immovable, and finely grooved on the convex side.

Plate III. fig. a. The Cobra-di-Capello (*Naja tripudians*) is yellowish brown and red. It has been known and dreaded for thousands of years, far beyond its Indian home. It grows to the length of five feet or more and is one of the most deadly snakes. When irritated it raises the fore part of its body and distends the mobile cervical ribs so as to form a large hood. Hence it is sometimes called

the Hooded Snake; or the Spectacle Snake, from the curious markings on the hood.

The Vipers have very wide jaws, and a curved movable poison-fang, with a closed or open channel for the venom on, each side of the upper jaw in front.

The head is broad and obtuse, the body thick and the tail short. They are not



Fer de Lance (*Bothrops lanceolatus*).

large snakes but very dangerous.

Plate II. Fig. b. The Viper or Adder (*Polias berus*) is our only venomous snake, though several others are found in Southern Europe.

The male is generally pale greyish brown and the female reddish brown or more rarely quite black,

which has given rise to its sometimes being regarded as a distinct species. Its most characteristic marking is a dark zigzag line running along the back, which forms an X-shaped marking on the head. It is generally about two feet long, and frequents dry sunny places. It does not increase very rapidly; for it has numerous enemies, and the female, which is viviparous, only begins to produce from five to fourteen living young in its fourth year. It is common in nearly all Europe.

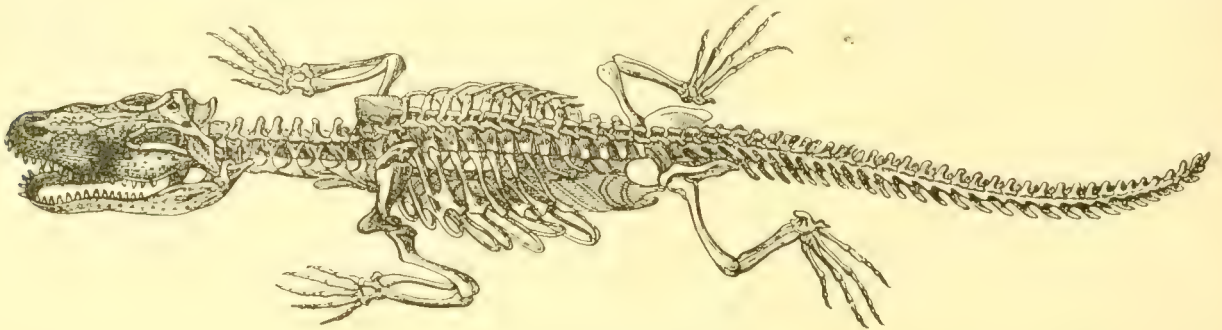
The Fer de Lance (*Bothrops lanceolatus*) has a triangular plated head, and attains the length of seven or eight feet, and is very variable in colour, though usually of a more or less bright reddish yellow. It is one of the most dangerous of venomous snakes, and is common on the sugar plantations in Martinique and Santa Lucia. When this snake strikes, it opens its jaws widely, darts forward, and then coils itself to prepare for another attack. (Figured on pag. 3.)

Order II. Crocodilia. (Crocodiles.)

In the Lizards and Crocodiles the difference between the head, body and tail is much better marked than in the snakes. The head is broad and flat and the jaws very long with two rows of teeth fixed in separate cavities. The nostrils and external ears can be closed by valves. The eyes are well developed and provided with broad eye-lids. The tongue is large, flabby and quite immovable. The body terminates in a long tail and is supported on four short legs. There are five toes on the fore-feet, but only four, which are webbed, on the

hind feet. The Alligators may be distinguished from the Crocodiles by their short broad snout, their only partially webbed hind feet and the ridges between the eyes. There is a hollow in the upper jaw for the reception of the fourth tooth of the lower jaw instead of a notch. The Alligator rarely attacks man, except in the water, but is often killed and eaten by the Indians, although its flesh smells strongly of musk.

Plate IV. fig. b. The Common Crocodile (*Crocodilus vulgaris*) is found in most African rivers,



Skeleton of Crocodile.

hind feet. The tail is long, laterally compressed, and very strong. The leathery skin is covered with horny plates. The Crocodilia lay hard-shelled eggs, and are found in warm climates.

The Alligators, of which there are several species, inhabit America.

Plate IV. fig. a. The Mississippi Alligator (*Alligator lucius*) inhabits the southern United States, where it lives in marshes, and on the banks of the Mississippi. It feeds both on fish and on land-animals, even attacking the jaguar when it comes to the river to drink. It grows to a length of about

15 or 16 feet. The Alligators may be distinguished from the Crocodiles by their short broad snout, their only partially webbed hind feet and the ridges between the eyes. There is a hollow in the upper jaw for the reception of the fourth tooth of the lower jaw instead of a notch. The Alligator rarely attacks man, except in the water, but is often killed and eaten by the Indians, although its flesh smells strongly of musk.

Order III. Lacertilia. (Lizards.)

The body is long and cylindrical, and the head is flattened and triangular. The gape is wide, and the eyes are large, and generally provided with two complete eye-lids. There is a distinct neck, the back is generally arched, and the tail is very long and tapering. The legs are generally well developed and the toes are armed with sharp claws, but the limbs are occasionally rudimentary or entirely wanting. The skin is covered with scales, which are hexagonal on the belly. The tongue varies according to the family. Lizards are to be met with in all parts of the tropical and temperate zones.

In the Monitors and Lizards the tongue is forked, narrow, and very extensile. The Nile Monitor (*Monitor niloticus*) is greyish brown, spotted with white, and grows to the length of five feet or more. It destroys the eggs of the Crocodile.



Nile Monitor (*Monitor niloticus*.)

Fig. b. The Sand Lizard (*Lacerta agilis*) is a very active little creature measuring about a span in length. The female is greyish brown whilst the male is of a bright greenish colour on the sides. In the summer they feed on insects and in the winter they hibernate. They are easily tamed if well fed and will take their food out of the hand. The yellowish-white eggs are covered with a parchment-like skin and are found in April or May among stones or sand in sunny places.

Fig. c. The Wall Lizard (*Lacerta muralis*) is longer and more slender than the last species. Its back is spotted with green, brown and black and its belly is white or reddish. The muzzle is very pointed, the scales on the back are small and granular, and there is a small plate among the scales on the temples. It is common in Southern and in many parts of Central Europe, and is often seen about walls, where it hides in the crevices, and is extremely active.

The Iguanas have a short, broad obtuse head, cylindrical body, and long tapering tail. The tongue is thick, short and fleshy, free only at the extremity, and not extensile. There is often a spiny crest running along the back, large throat-pouches, and other curious dermal appendages, which are sometimes supported by bones, and occasionally serve as a parachute. The legs are well developed, and the toes are long and slender, and armed with claws. The Iguanas feed on insects, and also on leaves and fruits. Some are found in rocky places, whilst others live on trees. They inhabit both the Old World and America.

Fig. d. The Iguana (*Iguana tuberculata*) is an inhabitant of tropical America, where its flesh and eggs are regarded as a delicacy. It is a large lizard, measuring from three to five feet in length. The whole body is covered with small scales the colour of which varies from bluish green to yellow. An upright spiny crest runs along the back, and there is a spiny pouch on the throat.

Fig. e. The Basilisk (*Basiliscus vulgaris*) is a harmless animal, which was regarded as extremely venomous by the early naturalists, and indeed this lizard which is twelve inches long, looks very uncanny. Its colour is bluish grey varied with white spots. Behind the head is a protuberance which can be inflated, and somewhat resembles a monk's cowl. There is a crest on the back and on a great part of the tail, and there is also a pouch beneath the

throat. It is found in South America, especially in dry, stony places where it feeds on insects, worms &c. It can also climb trees, and swims well.

Fig. f. The Flying Dragon (*Draco volans*) notwithstanding its resemblance in form to the dragons of the old story-books, is only a small East Indian lizard of about six inches in length, which feeds on insects, and is enabled to float from tree by a parachute-like expansion of skin, supported by prolongations of the ribs.

The Chamæleons are small lizards with a broad angular head, terminating behind in a kind of crest. They have a wide gape, and a long extensile and vermiform tongue, which they dart out at insects with lightning-like rapidity. The eyes are large and circular, each covered by only a single eye-lid. The body is laterally compressed, and the crest on the back is continued on the long prehensile tail. The legs are moderately long and slender, and the toes are opposable, as in climbing birds. The skin varies in colour according to the surroundings or emotions of the animal.

Fig. a. The common Chamæleon (*Chamæleo vulgaris*) is a sluggish animal which creeps slowly from branch to branch on trees and shrubs in search of insects, which it catches with its slimy tongue. The eyes move quite independently, so that one may be looking upwards and the other downwards. The Chamæleon inhabits South Europe, India and Africa.

In the Blindworms, the body is rounded, the head is triangular and there is no distinct division between the head, body and tail. The upper surface of the head is covered with plates but the rest of the body is scaly. The tongue is free and slightly extensile. The eyelids are freely movable. The limbs are short and weak, or entirely undeveloped. These reptiles live under stones in dry sandy places, and feed on insects, worms &c.

Plate III. Fig. d. The Blindworm (*Anguis fragilis*) was formerly regarded as a snake, but it is really a lizard, in spite of the absence of limbs. The body, which is cylindrical, and covered with shining brown scales, is as wide as the head, and the skull is shaped like that of a lizard. The Blindworm is about a foot in length. It prefers sunny places, and feeds on worms, insects and slugs. It is perfectly harmless, and so brittle that the slightest injury suffices to break off the tail.

Order IV. Chelonia.

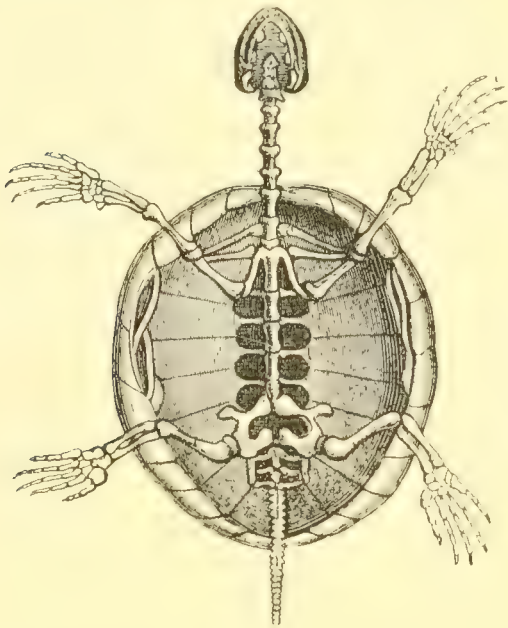
The animals included in this Order are very unlike any other Reptiles. The whole animal is clothed with an armour of bony plates covered with horn. This is composed of broad ribs fused with the vertebræ and with the breastbone. It contains the thoracic and abdominal organs, the bones of the shoulder and the pelvis, and the muscles acting on the upper part of the limbs. The only movable vertebræ are those of the neck and tail. Teeth are replaced in the Chelonians by a hard horny beak similar to that of birds. They also resemble birds in having a cloaca or common outlet for the contents of the bladder and intestines, and for the generative products. Moreover they lay hard-shelled eggs, which they do not sit upon, but bury in the sand or earth. Their tenacity of life and the age which they sometimes attain are extraordinary; and the length of time which they can exist without food is also remarkable. They live

either in the sea, in rivers and swamps, or on land, and feed on snails, worms, and small fish. Some feed also on vegetable substances. They inhabit both hemispheres.

In the Land Tortoises (*Testudinidæ*) the back-plate or carapace is high and arched, with narrow openings before and behind to receive the head, limbs and tail. The head is short and the legs moderately long. The toes are united into a thick mass, and are armed with horny claws. They are found in woods and thickets in warm countries.

Plate VIII. fig. b. The Common Land Tortoise (*Testudo græca*) is found on all the coasts of the Mediterranean. It is prettily coloured, the yellow plates are bordered with black, or the colours are reversed. It feeds on tender plants, insects, worms &c. In South Europe, where these animals are esteemed as an article of diet, they are often kept in gardens as pets.

The Freshwater Tortoises (*Emydidæ*) have more resemblance to marine turtles. The carapace



Skeleton of Tortoise.

(back-plate) and plastron (breast-plate) are both flattened, but are generally ossified, though the head and legs are not retractile. The head is long, the legs short, and the toes distinct, though webbed. There are five on the fore feet, and four on the hind feet. The water-tortoises are active creatures, living in streams and swamps, and feeding on fish and plants.

Fig. d. The Common River Tortoise (*Emys europæa*) inhabits a great part of Southern and Central Europe. Its carapace is oval and the colour is dark grey with yellowish-white streaks which radiate in all directions on each plate. Tortoises hibernate in winter in the mud.

The Sea Turtles (*Cheloniidæ*) are good swimmers and pass most of their lives in the water, except when they come to the shore to lay their eggs on sandy coasts. The carapace is small and pointed at the end, and only covers the body. The head is flat, the jaws sharp and beak-like and the neck short. The four legs end in undivided paddles. The toes are scarcely to be distinguished, and are often wholly without claws. The Turtles are of a large size, and feed on seaweeds and various marine animals.

Plate VIII. fig. a. The Green Turtle (*Chelonia midas*) inhabits the tropical seas, and when full-grown it measures six feet in length and weighs 700 lbs. The muzzle is obtuse and the plates of the carapace do not overlap. The flesh and eggs are excellent, and form a regular article of trade.

Fig. c. The Hawk's Bill Turtle (*Caretta imbricata*) furnishes the best tortoiseshell. The horny scales of the carapace overlap like slates on a roof. The tail is scaly and the upper jaw is notched and hooked. This species feeds on various marine animals, and not on seaweed like the Green Turtle and to this is ascribed the inferiority of its flesh. It inhabits the tropical seas of both hemispheres.

Class Amphibia.

The Amphibia are animals with cold red blood, imperfectly divided auricles, but only a single ventricle. Their skins with few exceptions are naked or warty. The limbs are generally well developed, but the toes are not clawed. Their jaws are armed with small teeth, and they are without ribs. After the young have left the egg they undergo metamorphoses which particularly affect the respiratory organs. All the *Amphibia* are carnivorous in the perfect state, feeding on worms, insects, slugs, &c.

The Amphibia are divided as follows:

- Order I. *Anoura*. Tail and gills lost in course of metamorphosis.
- „ II. *Urodela*. Tail retained, but gills lost.
- „ III. *Ichthyoidæa*. Gills and tail retained.
- „ IV. *Apoda*. Limbs and tail absent.

Order I. *Anoura*. (Frogs and Toads.)

(Plate VII.)

In adult animals the body is short, broad and tailless, with four limbs, of which the hind pair are the longest, being adapted for leaping and swimming, and the toes are generally webbed. The muzzle is rounded, and the gape wide. The tongue is generally fixed in front and free behind, and is adapted to seize insects. These are swallowed whole, for teeth, if present are only used to hold them. The lungs are elastic air-cavities, and are usually connected in the male with a single vocal sac (or sometimes a pair) situated in the throat. They are good swimmers and divers, and move on land by leaping. At the beginning of winter they bury themselves in

the mud, and remain there without eating or breathing. In the spring, when the spawning season begins, they emerge from their hiding places and become very lively. The spawn is laid in shallow water either in strings (as in the toads) or in lumps (as in the frogs) and when the young, which are called tadpoles, are hatched, they undergo the changes shown in



Skeleton of Frog.

Figs. a b I. d. I—4. and e. I. The little creature is at first legless, and has a tail and external gills, but as the lungs develop, the legs sprout, and the tail and gills disappear. These changes are accompanied by a change from vegetable to animal food, and require a considerable time (about 100 days in the edible frog) and the animals do not attain their full growth for several years.

In the typical Frogs (*Ranidae*) the skin is generally smooth, seldom warty. The upper jaw and generally the palate also are provided with teeth, but the lower jaw is seldom toothed. The tongue is either wholly fixed, or only attached in front to the lower jaw. The hind legs are much larger than the fore legs, and are adapted for leaping.

Fig. d. The Edible Frog (*Rana esculenta*) is thus called because its hind legs are eaten in spring in France, where they are considered a delicacy. It is of a beautiful green colour on the back, with black and yellow stripes, and the belly is white.



Bombardier (*Bombinator igneus*).

It hibernates in the mud, emerging in March, and spawning in June. Its favourite resorts are the grassy banks of ditches and ponds, into which it leaps with a great bound when alarmed. In the spawning season the frogs spend most of their time in the water, and the male croaks incessantly in the evening. In England this species is very local.

Fig. e. The Green Tree Frog (*Hyla arborea*) is much smaller than the edible frog. The upper surface of the body is green, and the belly white. In the male the green colour is bordered with black on the sides, and the throat is brownish. But the tree frogs are most remarkable for the pads at the ends of the toes, which are used as suckers in climbing trees and shrubs. These frogs also hibernate in the mud, and spawn in May or June in stagnant water. They are not found in England, though common on the Continent.

In the *Bombinatoridae* the hind legs are long, with the toes webbed, the skin is warty and the tongue completely fixed.

The Bombardier (*Bombinator igneus*) is found in marshes on the Continent. Its colour is greyish-brown above, and orange, spotted with black, below.

In the Toads (*Bufo*) the hind legs are rather long, the skin is warty, the parotid glands are large, and the teeth are absent.

Fig. a. The Common Toad (*Bufo vulgaris*) is uniform grey, or spotted with darker, above, and is dirty white beneath, with or without spots. It is a nocturnal animal, and lives in damp places in summer and autumn. It only visits the water in the spring, when it deposits its spawn in two strings. It is a useful animal in gardens and should be encouraged. It is perfectly harmless.

Fig. b. The Natterjack Toad (*Bufo calamita*) is fond of cellars and other dark damp places. It is olive brown above, and paler below. The warts on the

back are reddish brown, and there is a yellow streak along the back, which often takes the form of a cross. It is smaller than the common toad, its legs are shorter and stouter, and the hind toes are not webbed.

In the *Aglossidae* or Tongueless Toads, the head is flattened and triangular, the body broad, the front feet provided with four free toes and the hind feet with five webbed toes. The tongue is wholly wanting, and the jaws are either toothless, or provided with small teeth in the upper jaw only.

Fig. c. The Surinam Toad (*Pipa americana*) is much larger than our European toads, measuring nearly a foot in length. It inhabits the swamps of South America. The skin is grey spotted with white, and the back is perforated by small pits in the female, in which the eggs are placed after being laid, and where they are hatched, and the tadpoles reared to maturity.

Order II. Urodela. (Newts and Salamanders.)

The long body ends in a tail of variable length. There are four legs (rarely two) and the hind legs are scarcely longer than the others. Most species are aquatic, and use their laterally compressed tail as a paddle. The Salamanders, however, live on land, and have a cylindrical tail. They have teeth in both jaws, and sometimes on the palate too, which they use to seize their prey, for they are carnivorous animals. They all undergo a metamorphosis, and the

external gills which they require during the aquatic stage of their life are replaced by lungs when they are fully developed.

In the Salamanders and Newts, the gills are wanting in the full-grown animal, and the eyes are provided with well-developed lids.

The Salamanders (*Salamandridae*) frequent damp places, and feed on worms and snails. They are viviparous, the young undergoing their development

in the widened upper part of the oviduct. The tail is cylindrical, and there are large glands near the ear.

Plate VI. fig. a. The Spotted Salamander (*Salamandra maculosa*) is about six inches long, and is beautifully marked with black and yellow. It is found in dark and damp places, in many parts of the Continent of Europe. It is a rather sluggish creature. It was formerly supposed to be fire-proof and venomous.

The Newts (*Tritonidae*) have the tail laterally compressed, and suited for a propeller. They live in stagnant water, and lay their eggs singly on the leaves of water-plants. They are very active in the water, but are obliged to come to the surface every two or three minutes to breathe. In the winter they hibernate on land. They have a wonderful power of reproducing their limbs, if lost by accident.

Plate VI. Fig. b The Great Water Newt (*Triton cristatus*) the largest species found in Britain, is five or six inches long. The skin is warty, and its colour is dark brown, spotted with black above, and orange with dark spots beneath. The sides are dotted with white. The male has a large jagged crest on the back in the breeding season. The various stages of the development of the larva are represented at Fig. b. 1 to 5.

The Axolotl (*Siredon pisciformis*) the type of the family *Amblystomidae*, is eight or ten inches long. The body is dark brown with black spots, and the tail has a greenish lustre and is marked with pale spots. There are four toes on the front feet, and five on the hind feet. It is found in the lakes of Mexico, and is frequently exhibited in our aquariums. The immature form with gills is by far the most common.



Axolotl (*Siredon pisciformis*).

Order III. Ichthyoidea. (Sirens.)

The vertebrae are concave at the sides as in fishes. The head is flattened, and there are two or three branching tufts of gills at the sides of the neck. The body is long and narrow and the legs are weak. The eyes are either entirely hidden, or very small and without lids. The Sirens live in the water and are found in both hemispheres.

Plate VI. Fig. c. The Proteus (*Proteus anguinus*) is a queer eel-shaped creature with three prominent red tufts of gills on each side of the neck. It has four weak legs, the front feet having three toes, and the hind feet two. It is of a pale flesh-colour gradually passing into grey in the light. It is upwards

of a foot in length. It inhabits the subterranean waters of Carniola, and does not require eyes, which are only represented as small points under the skin. Both jaws are provided with slender teeth, but large enough to seize its prey.

Plate VI. fig. d. The Siren (*Siren lacertina*) is an ugly creature about two feet long, which resembles an eel. It has only a front pair of legs, and there are three tufts of external gills on the neck, which sprout from separate gill-slits. The eyes and nostrils are small, and the colour of the body is dark grey. These remarkable creatures inhabit the great swamps of South Carolina &c.

Order IV. Apoda.



Siphonops annulata.

These are worm-like animals with rings on the body, but without limbs or tail. One lung only is developed. They chiefly inhabit America, and attain a length of two or three feet. *Siphonops annulata* however, here figured, is a native of Ceylon. It is dirty grey in colour. There is not much known about its habits, except that it burrows in the ground with considerable strength and agility. It is usually met with in damp places, about one or two feet below the surface.

Class Pisces (Fishes).

Fishes are Vertebrate Animals with cold red blood, living in water, and breathing by gills or branchiæ. The heart has one auricle and one ventricle. The body is generally scaly; in some instances it is covered with plates, but is very rarely naked. They move by means of fins, which are bony rays connected by skin. The fins are partly horizontal, or paired (i. e. placed symmetrically on each side of the body), and partly vertical, or unpaired. The former are divided into pectoral and ventral fins, and the latter into dorsal, anal, and caudal, according to their position. The pectoral and ventral fins represent the fore and hinder extremities of the higher Vertebrata. The fins are divided according to their structure, into spinous fins, consisting of stiff unjointed rays; soft fins, consisting of jointed and sometimes branched rays, and fatty fins, unsupported by rays. The tail-fin is the principal organ of locomotion.

Most fishes, but not all, possess a curious air-bladder, consisting of a hollow sac filled with gas, which is connected in some species with the auditory organs, and in others with those of digestion. By its compression or expansion the fish is enabled to rise or sink

in the water. The form of fishes is generally rather long, and laterally compressed. The head is small, and the neck is wanting. The skeleton is either bony, or else more or less cartilaginous. The ribs are often very small, unconnected with a breastbone, and only enclose abdominal organs.

The organs of sense are not highly developed. The brain occupies a comparatively small portion of the cavity of the skull. The eye has usually no eyelids, a flat cornea, and a globular lens. The nostrils are only two blind cavities, and there are no external ears. The tongue is generally bony, and is often furnished with teeth. The teeth themselves vary extremely in size and position, and are generally used to seize and hold prey; rarely for mastication.

The breathing-organs, or gills, are thin, delicate and extremely porous layers, presenting a large surface in a small compass, so that they can contain

a large quantity of blood. They are either situated in a gill-cavity into which the water can penetrate through the gill-opening, which is closed by the gill-cover, and are then called internal gills, or in a few exceptional cases, they also project from the surface of the body into the surrounding water; and are then called external gills. Water, which contains air and oxygen, is taken in through the mouth, and when the mouth is closed, it passes into the gills, which lie on each side behind the head; and is afterwards discharged through the gill-openings. The fish can only breathe with its gills as long as they remain moist, as when they grow dry, the layers adhere together, and the blood can no longer circulate through them.

Different species of fishes inhabit salt and fresh water; and some can live in either. They are believed to be more numerous on the coasts than in open water.

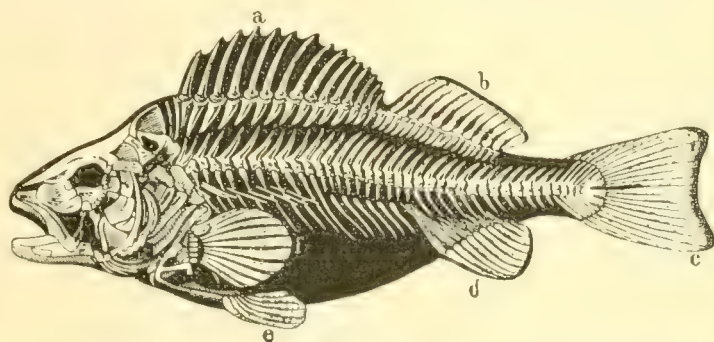
Most fishes are oviparous, but the number of eggs which they lay is very variable. In the herring the roes contain 30,000 to 40,000 eggs; in the carp 700,000, in the sturgeon 1,400,000, and in the cod as many as 13,000,000. Nevertheless the number of fishes tends rather to diminish than to increase, on account of

the number of other animals which prey upon them, including many species belonging to their own Class.

In the spawning-season many fishes which usually inhabit the sea, enter rivers for that purpose; and others, like the Herring, gather together in enormous shoals, and approach the coasts in search of suitable places to deposit their ova, when they are captured in enormous numbers.

Fish are extremely important as an article of food among all races of men. The only injurious species are some of the large sharks &c., and a few smaller fishes, which are poisonous.

As a rule, fishes are carnivorous animals, comparatively few, such as the Carps, feeding chiefly on vegetable substances. About 13,000 species are known at present; and the small number which we can find room to mention in the present work, may be arranged according to the following system;



Skeleton of Perch.

a Anterior dorsal fin. b. Posterior dorsal fin. c. Caudal fin. d. Anal fin.
e Ventral fin. f. Pectoral Fin.

Subclass I. Dipnoi.

Subclass II. Teleostei.

Order I. *Acanthopterygii*.
 „ II. *Pharyngognathi*.
 „ III. *Anacanthini*.

Order IV. *Physostomi*.
 „ V. *Plectognathi*.
 „ VI. *Lophobranchi*.

Subclass III. Chondropterygii.

Order I. *Ganoidei*.
 „ II. *Selachii*.

Order III. *Cyclostomi*.
 „ IV. *Leptocardii*.

Subclass I. Dipnoi.

Fishes which breathe with lungs and gills, and form a connecting link with Amphibia and Vertebrata.

The body is long and clothed with horny scales. The head is broad, the snout obtusely triangular, the nostrils open into the cavity of the mouth, and the two lungs open as in the higher *Vertebrata* by a common passage into the front wall of the gullet. The jaws and skeleton are in part cartilaginous.

Lepidosiren paradoxa, a very rare fish, inhabiting the Amazons and its tributaries, is greyish brown, and attains a length of three or four feet.

The Mudfish (*Protopterus annectens*) is found in the rivers of tropical Africa. It feeds on vegetable substances, and passes the dry season buried in caked mud. It grows to the length of five or six feet.

These fishes are allied to the genus *Ceratodus*, which was supposed to be extinct, until

living species were obtained from the rivers of Queensland.



Mud-Fish (*Protopterus annectens*).

Subclass II. Teleostei.

Fishes with a well-developed bony skeleton, and distinctly separated vertebræ, of the form of a hollow double cone.

To this Subclass most existing species of fish belong.

Order I. Acanthopterygii.

The front rays of the dorsal fin are undivided, and mostly consist of simple spines; and there are also some stiff rays in the front part of the anal fin. The lower pharyngeal bones are separated. The air-bladder is often absent.

Family I. **Gobiidæ**. These are usually small slender scaly fishes, in which the ventral fins are often united into a sucking disc. They are found at low water under stones.

Plate XI. fig. a. *Cyclopterus lumpus*, the Lump Fish, belongs to a section which possesses only three gills. It is found in shallow sea-water, and adheres very firmly to the rocks with its sucker. It is found in the North Sea, the Baltic, and in North America.

Plate XIV. fig. i. *Gobius niger*, the Black Goby, is, like most of the family to which it belongs, a little fish found between tidemarks in shallow water, where it seeks the bottom, and feeds on worms, spawn &c.

Family II. **Pediculata**. A small group of ugly fishes with a naked or warty skin, and very movable pectoral fins, which are situated behind the small gill-openings.

Plate XI. fig. b. *Lophius piscatorius*, the Fishing Frog, is common in the European seas, and attains a length of four or five feet. The head is very large, flattened and frog-like, the mouth wide, and armed with large teeth, adapted for seizing its prey.

Family III. **Percidæ**. The Perches are coarsely-scaled fishes with spiny fins, spines on the bones of the gill-covers, and one or two dorsal fins, of which only the first is usually spiny. They are all carnivorous.

Plate XV. fig. d. *Perca fluviatilis*, the Perch, is common in fresh water all over Europe. The back is of a greenish colour with dark transverse bands, and the fins are red. The Perch rarely

exceeds four or five pounds in weight, but is much esteemed for the table.

Plate XV. fig. e. *Lucioperca Sandra*, the Pike Perch, is a much larger fish, measuring three or four feet in length, which is common in the rivers and lakes of Eastern Europe, where it prefers clear water with a sandy bottom. Its head resembles that of a pike. There are 22 rays in the hinder dorsal fin, while the common perch has only 16.

Plate XV. fig. f. *Acerina cernua*, the Ruffe, is a small fish about six or eight inches long, found in rivers and lakes with a sandy bottom. It has a large head, a slimy body, and the undivided dorsal fin is only spiny in front.

Plate XV. fig. g. *Mullus barbatus*, the Red Mullet, is a beautiful fish. The variety figured, which is scarce in England, is of a red colour, with yellow stripes and fins. Its flesh is very delicate, and it was highly prized in Roman times, when it was almost worth its weight in gold. The first dorsal fin is spiny, the scales are easily removed, and there are two long filaments beneath the lower jaw. It is common in the European seas, growing to the length of about 18 inches, and varying much in colour.

Plate XIII. fig. a. *Uranoscopus scaber*, the Star-gazer, is a curious fish rather less than a foot long, which is found in the Mediterranean. The head is flat, the eyes quite on its summit, and the muzzle runs obliquely upwards. The small spiny dorsal fins, and the position of the ventral fin, which is placed just under the throat, are also remarkable.

Family IV. **Mugilidæ**. The Grey Mulletts have a large head, large scales over the gill-covers and the whole body, and a small spiny front dorsal fin, placed far from the hinder one, which is not spiny. They are sea-fish.

Plate XV. fig. i. *Mugil cephalus* is a species about a foot long, which does not extend very far north. It is fond of entering the mouths of rivers.

Family V. **Scombridæ**. The Mackerels are carnivorous marine fishes, variable in form, but usually with smooth bodies, and a spiny dorsal fin, behind which the hinder fin, which is often soft, runs to the tail.

Plate XIV. fig. e. *Scomber scomber*, the Mackerel, resembles a herring in shape, but is much larger, and is one of the worst foes of the latter fish. It is met with on the coasts of Europe in immense shoals.

Plate XIV. fig. f. *Thynnus thynnus*, the Tunny, is the largest fish of this family, attaining a length of from four to eight feet, and weighing several hundred pounds. The back is steel-blue, the sides silvery, and the ventral fins yellowish. It is found in other European seas, but is most abundant in the Mediterranean.

Plate XIV. fig. c. *Echineis naucrates*, the Sucking Fish, is about two or three feet long, and has a peculiar sucking apparatus on its head, consisting of 24 dentated bony transverse plates on the head and front of the body, formed of the modified dorsal fin. By this it can attach itself firmly to other fish, or to vessels, and thus travel from place to place. It is found in the Indian and Atlantic Oceans, and a smaller species (*Echineis remora*) in the British seas, as well as in the Mediterranean.

Plate XV. fig. a. *Zeus faber*, the John Dory, differs from the mackerels in its short and laterally-compressed body. The back is dark-coloured and the sides gilded, and marked with a conspicuous grey spot. The spines of the dorsal fin are produced into long filaments, and the mouth is tube-like and extensile. It is not an uncommon sea-fish, and is highly esteemed. It grows to the length of eighteen inches.

Family VI. **Labyrinthidæ**. Here we find the pharyngeal bones modified into a series of bony lamellæ which serve as water-reservoirs, and consequently the fish are enabled to exist for a long time out of water.

Plate XIV. fig. h. *Anabas scandens*, the Climbing Perch, is common in the East Indies, where it grows to the length of about 6 inches. It is said to climb trees by means of the spines on the ventral fins and on the gill-covers.

Family VII. **Xiphiidæ**. The Sword-fishes are large fish, which are chiefly met with in the tropical seas, where they pursue and impale other fish with the long sword-like upper jaw. There is a large spiny dorsal fin, the ventral fins, when present, are sword-like, and the tailfin is strongly concave.

Plate XII. fig. i. *Xiphias gladius*, is common in the Mediter-

anean, where it is captured with harpoons, and eaten. It grows to the length of 11 or 12 feet, and the sword is 3 or 4 feet long. It is met with in the Atlantic Ocean, but less commonly than in the Mediterranean.

Family VIII. **Triglidæ**. This family includes fishes remarkable for the mail-clad head.

Plate XIV. fig. d. *Scorpena scorpio*, the Red Scorpion-fish has a strangely-shaped head with jagged appendages, there is only one dorsal fin, and the ventral fin is placed below the large pectoral fins. It is found in the European seas, and rarely exceeds eighteen inches in length.

Plate XIV. fig. g. *Gasterosteus aculeatus*, the Stickleback, is a voracious little fish, about two inches long, which abounds in rivers and streams. Its whole body is clothed in mail, and it has three spines in front of the dorsal fin, and another on the belly. It is one of the few fish which are known to protect their young. The male makes a nest among



Stickleback and nest.

water-plants, in which the eggs, which he carefully watches over, are hatched.

Plate XIV. fig. b. *Cottus gobio*, the Bullhead, is another little fish, about twice the size of a Stickleback, which is abundant in clear pebbly brooks. It has a large head and scaleless body, mottled with black and brown above, and yellow beneath. It feeds, like the Sticklebacks, on insects, and on the roe and fry of fish.

Plate XIV. fig. k. *Trigla Gurnardus*, the Grey Gurnard, is a common marine fish about six inches long. It produces a grunting noise when captured, by forcing gas from the air-bladder. The head is plated, and there are three free spines in front of the dorsal fin.

Plate XIV. fig. l. *Dactylopterus volitans*, the

Flying Gurnard, has very long pectoral fins, and when pursued, it can raise itself from the water and fly a distance of 100 paces. They abound in the Mediterranean.

Family IX. **Blenniidae**. These fishes have a slimy skin, small belly-fins, and a large dorsal fin.

Plate XII. fig. h. *Anarrhichas lupus*, the Wolf-Fish, is commoner in Northern than in Temperate climates, and grows to the length of seven feet and upwards. It has very powerful teeth, and is exceedingly voracious.

Plate XIV. fig. a. *Blennius viviparus* is interesting on account of its producing living young. It has two small filaments on the mouth, and the nostrils are tube-like. It inhabits the North Sea and the Baltic, and grows to the length of ten inches.

Order II. Pharyngognathi.

This Order is distinguished by the lower pharyngeal bones being united. It includes, among others, the family **Labridæ**. They are brightly-coloured fishes with thick lips, a protuberant snout, and strong teeth. The body is generally laterally

compressed, with large smooth scales. — Plate XV. fig. h. *Julis mediterranea* is a pretty species of Wrasse which inhabits the European seas. It is blue with an orange-coloured band on the sides. It is about as long as a finger.

Order III. Anacanthini.

Fins with soft rays, and not spines; air-bladder without pneumatic duct. Ventral fins, when present, placed just below to the throat.

Family I. **Gadidæ**. The species frequent the northern seas, and very few are inhabitants of fresh water. They are long fishes, with a flattened head, a wide mouth, well provided with teeth, short ventral fins placed in front of the pectoral fins, and a long tail. They are carnivorous fishes, which are abundant in the Northern seas, and are of great economical value. Many of them measure three or four feet in length.

Plate XIII. fig. b. *Merluccius vulgaris*, the Hake, is common in the European and North American seas. It has two dorsal fins, and the lower jaw projects like that of the pike.

Plate XIII. fig. c. *Molva vulgaris*, the Ling, is a long and narrow fish, with a projecting upper jaw, and barbels on the lower jaw.

Plate XIII. fig. d. *Gadus morrhua*, the Cod, is the most valuable of the whole family, and is particularly abundant on the Banks of Newfoundland. It is a most prolific fish, and though it is annually salted by millions, its numbers never appear to diminish.

Plate XIII. fig. e. *Gadus aeglefinus*, the Haddock, is brown on the back, and silvery on the sides and belly, with a dark spot behind the pectoral fins. It is a rather smaller fish than those previously mentioned, not exceeding three feet in length.

Plate XIII. fig. f. *Gadus callarias*, the Dorse, is about the size of a Haddock, and is not found so far north as the other common species of *Gadidæ*. It has 3 dorsal and 2 ventral fins, a barbel on the chin, and a waved lateral line running across the pectoral fins. Some authors regard this fish as only a young cod.

Plate XIII. fig. g. *Gadus minutus* is yellowish brown above, and only measures about six inches in length. Its appearance on our coasts heralds that of the larger species.

Plate XIII. fig. h. *Lota vulgaris*, the Eel-Pout, is a remarkable freshwater-fish, common in the lakes and rivers of Europe and Northern Asia. It is a queer-looking fish, with a frog-like head, barbels on the chin, and an eel-like body. It grows to the length of three feet. The flesh is best just before the spawning-season, in December.

Family II. **Pleuronectidæ**. The Flat-fishes have no air-bladder, and have an extremely high and narrow body. When swimming or at rest they lie on one side, and consequently only the upper side of the body is coloured, and both eyes are placed on the coloured side of the head. They generally rest on the bottom of the sea, but some species ascend rivers to a considerable distance. They feed on small fish, worms and Crustacea.

Plate XV. fig. b. *Pleuronectes platessa*, the Plaice, swims with the right side uppermost. It is brown with red spots, and grows to the length of eighteen inches. It is an extremely common species.

Plate XV. fig. c. *Hippoglossus vulgaris*, the Halibut, is one of the largest of the flat-fishes, attaining a length of from five to seven feet, and weighing 200 or 300 pounds. The body is smooth, and the tail crescent-shaped. It is commoner in Northern Europe than on the British coasts.

Family III. **Scombresocidæ**. The jaws are prolonged into a beak, and there is a double keel on the belly. These fishes are all marine.

Plate XVI. fig. e. *Exocoetus volitans*, the Flying Fish, resembles a herring, but the pectoral fins are so long and so strong that the fish can fly for a hundred yards over the surface of the sea. The Flying Fish are common in the warmer seas; but the species figured is occasionally seen on our own coasts.

Plate XIX. fig. i. *Belone vulgaris*, the Garfish, has both jaws prolonged into a sharp horny beak. It is a deep-water fish, but comes to the coasts to spawn. The spine is green. It attains a length of upwards of two feet.

Order IV. Physostomi.

These are fishes with soft jointed fin-rays, the air-bladder is almost always provided with a pneumatic duct, and the ventral fins, if present, are placed behind the pectoral fins. The pharyngeal bones are separated.

In the first two families, the body is snake-like, slimy, and naked, and the ventral fins are absent. The gill-cavities are large, but the gill-openings small, thus enabling the fish to live for a long time out of water. They are carnivorous fishes, and are found both in the sea and in fresh water.

Family I. Gymnotidæ. The gill-openings are placed laterally over the small pectoral fins. Vent placed below the throat; and behind it is the long anal fin. Dorsal and caudal fins absent or nearly so.

Plate XII. fig. e. *Gymnotus electricus*, the Electric Eel, is common in the lakes and swamps of South America, where it grows to the length of six feet. Its electric discharge is sufficiently powerful to kill small animals, and to disable large ones. The electric organs consists of two assemblages of prismatic cells filled with a jelly-like substance.

Family II. Murænidæ. In the Eels, the vent is placed far from the throat, and there is usually a long dorsal fin.

Plate XII. fig. f. *Anguilla fluviatilis*, the Common Eel, is dark green above with the sides paler, and the belly yellowish, with fine scales under the skin. It generally measures two or three feet in length, but sometimes attains a larger size. In warm weather they not unfrequently leave the water for a short time.

Plate XII. fig. g. *Muræna Helena* is spotted with brown and yellow, and has no pectoral fins. It grows to the length of three feet, and is common in the Mediterranean and Indian Oceans. This fish was greatly prized by the ancient Romans, and was reared by them in large fish-ponds, and fed on meat.

In the remaining families of the *Physostomi*, ventral fins are present, and are situated behind the pectorals. The majority of the species are found in fresh-water.

Family I. Clupeidæ. Body long, with thin scales which easily fall off. Gape wide, air-bladder simple. They are marine fish which approach the coasts in vast shoals in the spawning season, and are caught by millions.

Plate XVI. fig. f. *Clupea harengus*, the Herring, inhabits the northern seas as far as 67 degrees North; and the shoals appear on our coasts in summer to spawn. The back is blackish, and the body silvery. They are eaten both fresh and salted.

Plate XVI. fig. g. *Engraulis encrasicolus*, the Anchovy, is smaller than the Herring, and may be recognised by its wide gape and projecting snout. It is common in the European seas, especially in the Mediterranean, from whence it is largely exported to all parts of the world.

Family II. Siluridæ. These are carnivorous freshwater-fishes, and are most abundant in the lakes and rivers of warm countries. The head is flat and broad, and always provided with barbels. In many species the first ray of the pectoral fins is converted into a strong spine. There is frequently an adipose fin on the back. The skin is either naked, or covered with bony plates.

Plate XVI. fig. d. *Silurus glanis*, the only European species of the family, is also one of the

largest of the European fresh-water fish, measuring upwards of six feet in length, and weighing 300 or 400 pounds. There are two long barbels on the upper jaw, and four shorter ones on the lower jaw. It is greenish black above, and marbled with paler below; and the whole body is spotted with black. It frequents still water with a muddy bottom, and is found in the rivers of Eastern Europe.

Family III. Cyprinidæ. The air-bladder has a transverse division. The mouth is small, and only the lower pharyngeal bones are provided with teeth, and the fishes are probably carnivorous as well as herbivorous. The body is more high than broad, and is usually scaly. They are common in rivers and ponds.

Plate XVI. fig. a. *Nemachilus barbatulus*, the Loach, is common in gravelly brooks, and lurks under stones. The skin is marbled with grey and white, and the mouth is furnished with six barbels. It is about four inches long.

Plate XVI. fig. b. *Nemachilus fossilis* is a larger fish about a foot long. It has ten barbels round the mouth, and is black above, with yellow longitudinal stripes on the sides, and the belly is dotted with orange and black. It is found in lakes and rivers with a muddy bottom, and has the curious habit of stirring up the mud before a storm.

Plate XVI. fig. c. *Cobitis tania* is a small fish about three inches long, which is not common in England. The back is grey, spotted with yellow and black, and there is a spine under each eye.

Plate XVI. fig. h. *Cyprinus carpio*, the carp, is common in the rivers and lakes of Europe and Asia. It has four barbels, and there are 5 pharyngeal teeth arranged in three rows. The scales are large, and dark green on the back, yellowish on the sides, and white on the belly. It is said to live to the age of a century, and to attain the length of four or five feet, and a weight of upwards of forty pounds.

Plate XVII. fig. c. *Carassius carassius*, the Crucian Carp measures a foot in length and half as much in breadth, amid favourable surroundings. It has an arched back, and large greenish-golden scales. It has no barbels, and its habits are that of the common carp. It is common in many parts of Europe.

Plate XVIII. fig. i. *Carassius auratus*, the Gold Fish, is a native of China, but is now domesticated in all parts of the world for the sake of its beautiful golden-red colour, which is gradually developed, as it grows, from the dark grey hue which it at first exhibits. It becomes very tame when kept in glass globes, but does not grow so large as in ponds.

Plate XVI. fig. i. *Tinca vulgaris*, the Tench, is a slimy fish with very small scales found in muddy water. It has only two barbels, and weighs from one to two pounds. There is a golden variety of this fish also.

Plate XVIII. fig. c. *Rhodeus amarus* is a small fish about three inches long, found in some parts of Eastern and Central Europe in running water. There are no barbels, and the male and female differ in colour; the latter is provided with a long ovipositor.

Plate XVII. fig. a. *Abramis brama*, the Bream, has a broad flat body, and no barbels, and attains a length of two or three feet, and a weight of from

ten to twenty pounds. The back is blackish, and the sides are yellow, white, and black. It is very common in rivers and large lakes.

Plate XVIII. fig. h. *Abramis blicca*. This is a smaller species of bream, found in lakes and slowly flowing rivers with a sandy bottom. It grows to the length of nearly a foot.

Plate XVIII. fig. d. *Abramis vimba* has a projecting upper jaw, and a rather long anal fin. It is found in the large inland seas of Europe, and enters the rivers to spawn. Unlike the other species of Bream, it is considered very good food.

Plate XVII. fig. d. *Leuciscus erythrophthalmus*. the Rudd, is found in lakes and rivers with a sandy bottom, and grows to the length of about a foot. The back is dark brownish grey, the sides and belly white, the latter ridged. The fins are red, and there is a yellowish red circle round the eye. The pharyngeal teeth are arranged in two rows.

Plate XVII. fig. e. *Leuciscus rutilus*, the Roach. The fins and rings round the eyes are brighter red than in the last species; the dorsal fin is placed rather more forward, the snout is less oblique, and the pharyngeal teeth are arranged in one row. The belly is not ridged. It is commoner and better known in England than the last species.

Plate XVII. fig. f. *Leuciscus cephalus*, the Chub, grows to the length of upwards of two feet. It frequents lakes and rivers, but comes into smaller streams to spawn. The pharyngeal teeth are arranged in a double row. The gape is wide, and the anal fins are convex. It is not considered worth eating.

Plate XVII. fig. g. *Leuciscus idus* has a thick, truncated head, and bluish violet scales. It is found in swiftly-running waters in some parts of the Continent. Its flesh turns yellowish when cooked.

Plate XVII. fig. b. *Leuciscus orfus* is only a golden variety of the last, reared in some places in fish-ponds for ornament, like the common Gold-fish.

Plate XVII. fig. h. *Leuciscus vulgaris*, the Dace, resembles the Chub, but the head and snout are smaller, and the anal fin concave. It grows to the length of eighteen inches.

Plate XVIII. fig. c. *Leuciscus phoxinus*, the Minnow, is a little fish which swims about among the roots of water-plants near the edge of streams and ditches.

Plate XVIII. fig. a. *Leuciscus alburnus*, the Bleak, is another small fish, about two inches in length, which is common in streams and lakes. The body is long, the snout oblique, the chin prominent, and the anal fin long. The friable silvery scales are used in the preparation of artificial pearls.

Plate XVIII. fig. f. *Gobio vulgaris*, the Gudgeon, is a little larger than the Bleak, and is found in streams with a clear sandy bottom, where it feeds on worms, small Crustacea, and the fry of fish. The body is round and spotted, and there is a small barbel at each corner of the mouth.

Plate XVIII. fig. b. *Chondrostoma nasus* derives its name from its prominent snout. It is not worth eating, but attains a weight of two pounds.

Plate XVIII. fig. g. *Barbus vulgaris*, the Barbel, much resembles a pike, except for the head, which is distinguished by the projecting upper jaw, and four barbels. The Barbel is found in running water, where it feeds on fish and worms, and spawns from May to July. It is rather a large fish, and sometimes weighs upwards of twelve pounds.

Family IV. **Salmonidæ**. The Salmon are slender tapering brightly coloured fish, with an adipose fin behind the dorsal fin. The air-bladder is simple. They are either toothless, or there are teeth on all the bones of the mouth. Most of the species are carnivorous, and live in clear fresh water, but others are marine, and only ascend the rivers to spawn.

In the genus *Salmo* the mouth is well provided with teeth.

Plate XVIII. fig. k. *Salmo salar*, the Salmon, may grow to a length of six feet, and weigh fifty pounds. The head and back are blackish, the sides bluish, and the belly silvery. They usually live in the sea, but enter rivers at the spawning-season, leaping over waterfalls, weirs, and other obstacles in their way, and spawning in clear gravelly streams, where they are captured in large numbers.

Plate XVIII. fig. l. *Salmo fario*, the Trout, does not generally exceed a foot in length and half a pound in weight. The upper part of the body is spotted with red, and the spots are often bordered with blue; the lower jaw is rather prominent. It loves clear cool water, and feeds on fish, crustacea, insects &c. It spawns at the beginning of winter.

Plate XIX. fig. a. *Salmo trutta*, the Salmon Trout has blackish spots surrounded with a paler ring, and attains a weight of ten or twelve pounds. It ascends rivers from the sea, but not so high as the salmon.

Plate XIX. fig. c. *Salmo lacustris*, the Lake Trout, is distinguished from the Salmon by its small scattered crescent-shaped spots. The flesh is yellowish. It is found in large lakes, and grows to the weight of fifty pounds.

Plate XIX. fig. b. *Salmo hucho* is found in the Danube and its southern affluents, where it grows to the length of six feet. The head is rather pointed, and the body and fins (except the pectorals) are covered with round brown spots.

Plate XIX. fig. d. *Salmo salvelinus* inhabits the lakes of Southern Germany and Austria, and may be recognised by the prominent upper jaw, and the orange-yellow spots, bordered with white, on the sides. It weighs from two to ten pounds.

Plate XIX. fig. e. *Thymallus vulgaris*, the Grayling, resembles the Trout in form, and in its preference for clear cool mountain-streams, but it is a rather larger fish with a small gape, a broader belly, and ash-coloured sides. It spawns in April and May.

Plate XIX. fig. f. *Coregonus wartmanni* is a representative of an almost toothless genus. The long body is blue above and on the sides, silvery beneath, and not spotted. It is found in the lakes of Southern Germany, where it is captured in as great abundance as the herring in the Northern seas. It attains a length of two feet, and spawns in December.

Plate XIX. fig. g. *Osmerus eperlanus*, the Smelt, has a wide mouth, well furnished with teeth. Its head looks semitransparent, and it has a projecting lower jaw. The back is grey, the sides greenish blue, and the belly reddish. It spawns in May, and is taken in large numbers in lakes and estuaries.

Family V. **Esocidæ**. These are voracious fishes, found only in fresh water, and confined to the North Temperate Zone. The head is compressed and beak-like, and the mouth is armed with formidable teeth. Air-bladder simple. Adipose fin absent.

Plate XIX. fig. h. *Esox lucius*, the Pike, preys on all the inhabitants of fresh water, and grows rapidly, sometimes attaining the length of six feet. The pike will even attack water-birds and small

mammals. It is green when young, but afterwards grows darker above; the sides are grey and yellow, and the belly white, dotted with grey.

Order V. Plectognathi.

Body short, either conical or laterally compressed. Head very large; upper jaw with the bones coalesced; gill-openings small; fins only slightly developed, but the dermal covering very solid, as the leathery skin is generally either scaly, spiny, or covered with angular bony plates.

Family I. **Sclerodermidæ**. Mouth small, armed with one row of oblique teeth. Body covered with horny plates.

Plate XI. fig. f. *Ostracion cornutus*, the Horned Trunk-Fish, is about a foot in length, and is enclosed in an armour of hexagonal plates, which only allows it to move the head and tail. It is rendered still stranger in appearance by two long spines in front of the eyes, and two more before the tail. It is found in the tropical seas.

Family II. **Gymnodontidæ**. The jaws form a sharply pointed beak, without teeth, but provided

with a dental plate for crushing molluscs. Skin leathery, sometimes furnished with erect spines. There is a large air-bladder, and a pouch in the throat which can be inflated.

Plate XI. fig. g. *Diodon hystrix*, the Sea-Hedgehog is completely covered with spines. When it inflates its body, it becomes perfectly round, and is then unassailable. It inhabits the tropical seas, and attains a length of at least two feet.

Plate XI. fig. h. *Tetrodon stellatus* is a native of the East Indian Seas, and can inflate itself to such an extent that even the head is no longer visible.

Plate XII. fig. a. *Orthogoriscus mola*, the Sunfish, has a short flattened tailless body, truncated behind. The skeleton consists of short filaments, and the skin is rough and granulated. The Sunfish has no air-bladder, and cannot inflate itself. It is of occasional occurrence in the Atlantic and Mediterranean, and grows to the length of six or seven feet.

Order VI. Lophobranchi.

Small fishes, entirely covered with bony plates, mostly quadrangular, and a long tubular toothless snout, with a narrow mouth-cleft at the extremity. Gill-covers large; gills lamellated. Fins usually imperfectly developed, but the dorsal fin, which acts like the screw of a steamship, is always present. They live in the sea among tangle; and the male (or in some genera the female) is provided with a pouch in which the eggs are carried about until the young are matured.

Plate XII. fig. b. *Syngnathus acus*, the Great Pipefish, grows to the length of eighteen inches, and to the thickness of a swan-quill; and is common in the Atlantic Ocean. The scales are heptagonal in front, pentagonal further back, and quadrangular on the tail. In spring, the male carries a pouch of eggs at the root of the tail, covered by two folds of skin

Plate XII. fig. c. *Hippocampus antiquorum* is a small fish about eight inches long, found in the European and Eastern seas. The fishes of this genus are called Sea-Horses from the curious resemblance of the head to that of a horse, and this resemblance is increased by their generally swimming in an upright position. The body is seven-sided, and at the base of the quadrangular tail, with which they like to cling to the sea-weed, is a pouch in the male for the reception of the eggs.

Plate XII. fig. d. *Pegasus draco*, the Sea-Dragon, is found in the Indian Ocean, and is about three inches in length. The mouth is placed beneath the long projecting snout, the pectoral fins expand like great wings, and the ventral fins are reduced to mere threads.

Subclass III. Chondropterygii.

Fishes with a cartilaginous skeleton.

Order I. Ganoidei.

These form a transition to the fishes with a bony skeleton. Their skeleton is partly cartilaginous and partly osseous. The gills are free, and provided with gill-covers. The body is generally covered with enamelled scales of various forms. Most fossil fishes belong to this Order.

The *Acipenseridæ* are long fishes with a cartilaginous skeleton, and 5 longitudinal rows of enamelled bony plates on the skin. The snout is prolonged into a beak, and the oblique mouth is toothless. They are found in the seas of both hemispheres, but

ascend large rivers to spawn, and feed on other fish, notwithstanding their toothless jaws.

Plate XI. fig. c. *Acipenser sturio*, the Sturgeon, which is found in the European seas, usually attains a length of nine feet, and sometimes grows to twice that size, and weighs 800 pounds. The colour is bluish-green, varied with brown and blackish markings. It is an important object of trade in Russia, where its roe is made into caviare, and its air-bladder into isinglass.

Plate XI. fig. d. *Acipenser huso* which is found in the Black Sea and sometimes in the Mediterranean,

is larger still, and sometimes weighs upwards of a thousand pounds. In the spawning season, it ascends the Volga and other large rivers, where it is speared, or taken in strong nets.

Plate XI. fig. c. *Acipenser ruthenus*, the Sterlet,

measures less than four feet in length, and does not exceed thirty pounds in weight. It is found in the seas and rivers of Eastern Europe, and is more highly esteemed than the larger species.

Order II. Selachii.

Cartilaginous fishes with large pectoral and ventral fins, usually with the mouth transversely opening below the projecting snout. Five gill-openings (rarely one) on each side, without gill-covers. They are marine fish, but are sometimes seen in estuaries.

Family I. **Carchariidæ**. The Sharks have a long tapering body, erect dorsal fins, and a large fleshy tail. The eyes have well-formed lids, and the mouth is furnished with several rows of large sharp teeth. The larger species grow to the length of thirty feet.

Plate IX. fig. a. *Carcharias vulgaris*, the common Shark, is found in all seas, and is an excellent swimmer, which will follow the swiftest vessel for days, feeding on any offal which may be thrown overboard, and not unfrequently devouring men, if they fall into the water. The skin is as rough as a file, from embedded calcareous particles, and is called shagreen. The liver yields excellent oil.

Plate IX. fig. b. *Zygæna malleus*, the Hammer-headed Shark, is also a formidable creature, which grows to the length of nine feet or more, and is as voracious as a shark. Its head has two lateral expansions, at the ends of which the eyes are fixed, and the snout is truncated. It is found in the Atlantic Ocean and in the Mediterranean.

Plate IX. fig. c. *Pristis antiquorum*, the Saw-fish, is a still stranger-looking fish than the Hammer-

head. It has a powerful weapon on the form of a long flattened saw-like extension of the upper jaw, with which the Saw-fish does not fear to attack the largest monsters of the deep. The Saw-fishes inhabit tropical seas.

Family II. **Raiidæ**. In the Rays the body is very broad and depressed, with the eyes on the depressed surface, and the mouth and gill-opening beneath. The breadth of the body is increased by its expanding into the pectoral fins. The teeth are broad, obtuse, and arranged like paving-stones. These fish swim badly, and generally rest at the bottom of the sea. Some species can give an electric shock.

Plate X. Fig. a. *Myliobatis aquila*, the Eagle Ray, has a long saw-like spine at the end of the tail. It is more common in the Southern Seas than in ours.

Plate X. fig. c. *Raia clavata*, the Thornback Skate, is common in the Northern Seas. It derives its name from the numerous spines scattered over its body, and even between the eyes and the snout.

Plate X. fig. b. *Torpedo marmorata*, the Torpedo, is commoner in the Mediterranean, and other warm seas, than in those of Northern Europe. The tail is short, the naked body nearly round, and the teeth are small and sharp. The electric organ is situated between the pectoral fins and the head, and consists of numerous vertical quadrangular or hexagonal prisms, filled with a sort of jelly, and traversed by large branching nerves.

Order III. Cyclostomi.

These are cartilaginous fishes of a very low grade, with cylindrical bodies, no pectoral nor ventral fins, a ring-like sucking mouth, and fixed gills, without gill-covers. They live in both salt and fresh water, and are in part parasitic on other fish, to which they fix themselves.

Family I. **Petromyzidæ**. The sucker-like mouth is formed either of a single round toothed lip, or of two unequal toothless lips. There are seven gill-openings on each side of the neck, which were formerly supposed to be eyes. Most of the species live in clear streams under stones; but a few are marine.

Plate X. fig. d. *Petromyzon marinus*, the Lamprey, which sometimes measures three feet in length, is common on the coasts of Europe, but comes into rivers to spawn. It is green marbled with brown on the back and sides, and the belly is white. It has a round toothed snout, with which it can fix itself very firmly to rocks.

Plate X. fig. e. *Petromyzon fluviatilis*, the Lampern is dark green on the back, with yellowish sides, and white beneath. It grows to the length of about eighteen inches, and is very common in rivers, where it spawns among stones in spring.

Plate X. fig. f. *Petromyzon Planeri*, the Small Lampern, is likewise a common river fish but is much smaller, hardly exceeding a foot in length. It is olive-green, and differs from the other species in the continuous dorsal fin.

Plate X. fig. g. The immature form of the last fish is known as the Mud Lamprey, and was formerly considered to belong to a distinct genus, being called *Ammocætes branchialis*. It is a wormlike creature, about six inches long, and likes to attach itself to the gills of other fish. It lives in muddy brooks, and fishermen sometimes use it for bait.

Family II. **Myxinidæ**. These are small parasitic fish, without lips.

Order IV. Leptocardii.

The Lancelet (*Branchiostoma lanceolatum*) is a small creature about three inches long, without pectoral or ventral fins, brain, skull, or heart, the place of the latter being supplied by pulsating vessels. Se-

veral recent authors do not regard it as a fish at all, but place it in a class, by itself, or even as the type of a distinct subkingdom from the Vertebrata.

Subkingdom Articulata. Jointed Animals.

In these animals, the symmetrical body is divided into a series of rings called segments, which are jointed together. There is no skeleton, but its place is supplied by the skin, which is usually hard, and often covers the internal organs like a coat of mail, and serves as a support for the attachment of powerful muscles. The nervous system

consists of two cords, which run along the under-surface of the body, and are connected by knots called ganglia. Above the mouth are two large ganglia with which the cords commence, and which form a kind of brain. Creatures of very different form and habits are included in the Articulata.

Class Insecta.

Invertebrate animals, with the body composed of three different divisions, the head, thorax, and abdomen. The head is provided with eyes, antennæ, and mouth-organs adapted either for biting or for sucking; and the thorax bears the organs of locomotion, which consist of three pairs of jointed legs, and in most cases, of two pairs of wings.

Insects do not breathe by means of lungs or gills, but by tracheæ, or air-tubes, which open on the sides of the body. Insects lay eggs, but pass through four stages of existence in which they differ more or less in appearance and habits; namely, the egg, the larva or caterpillar, the pupa or chrysalis, and the imago or perfect insect.

Insects are extremely numerous, both in species and individuals; and they are found everywhere on land and in fresh water, though very few true insects inhabit the sea, where their place is filled by the Crustacea. 260,000 species of insects are known at present, and thousands more remain to be discovered, while in England we have about 12,000 species. They feed on all kinds of animal and vegetable substances, and there is no plant which is not liable to the attacks of various species; and none more so than the oak, which provides food for several hundred different species of insects, many of which are never found on any other plant.

Insects are divided into seven principal Orders, as follows:

a) Insects with perfect metamorphoses:

- | | |
|---|--|
| 1. <i>Coleoptera</i> (Beetles). | 3. <i>Lepidoptera</i> (Butterflies and Moths). |
| 2. <i>Hymenoptera</i> (Bees and Wasps). | 4. <i>Diptera</i> (Two-winged Flies). |
| 5. <i>Neuroptera</i> (Dragonflies &c.). | |

b) Insects with imperfect metamorphoses:

- | |
|---|
| 6. <i>Orthoptera</i> (Grasshoppers and Crickets). |
| 7. <i>Hemiptera</i> (Bugs). |

Of these, Orders 1, 2, 5 and 6 have biting jaws in the perfect state, and are called *Insecta Mandibulata*; and Orders 3, 4 and 7 have mouth-

organs adapted for suction in the perfect state, and are called *Insecta Haustellata*.

Order I. Coleoptera. (Beetles).

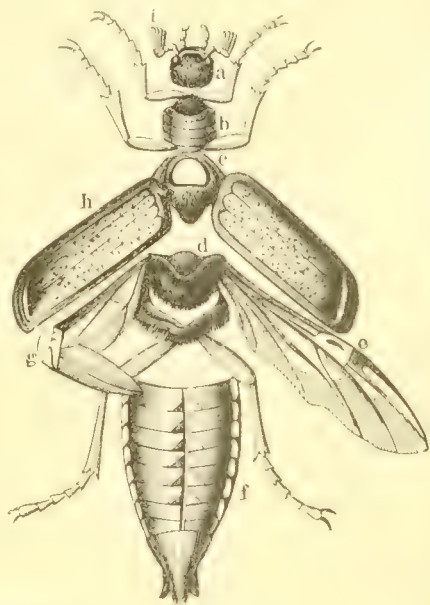
Plate XXIV (left side).

These are mandibulate insects with perfect metamorphoses. The organs of the mouth consist chiefly of the upper and lower jaws, (mandibles and maxillæ) an upper and lower lip (labrum and labium) and the chin (mentum). The maxillæ are provided with one or two pairs of jointed organs, called maxillary palpi, and the labium with one pair, called labial palpi. The antennæ differ in length in different species, but usually consist of 11 joints. The front wings are called elytra, or wing-cases, and are hard and horny, and the hind wings, which are the true organs of flight, and which are generally colourless

and transparent, are folded beneath them. The larvæ are usually worm-like, with six legs, and a horny head. The pupa is motionless, but exhibits the outline of the perfect insect. The accompanying figure represents the principal parts of the body of a cockchafer. *a.* Head with antennæ *i* and projecting maxillary palpi. *b.* Prothorax, and first pair of legs. *c.* Mesothorax, with the middle legs, and elytra *h.* *d.* Metathorax, with the hind legs and wings *e.* *g.* shows how the wings are folded when not in use. *f.* Abdomen, consisting of 9 segments. This structure is common to all

insects; though in some species the segments of the abdomen are soldered together, so that they are not all visible. Besides the nine principal segments, there are one or two smaller and less conspicuous terminal ones. The feet (or tarsi) in beetles may have 3, 4, or 5 joints.

There are more than 100,000 species of beetles known, of which 3,000 inhabit England. We have given illustrations of several of the principal European families.



Fam. I. Cicindelidæ. (Tiger-Beetles.) These are carnivorous beetles, with sharp strong jaws, long slender legs, filiform antennæ, and five-jointed tarsi. Their larvæ live among sand in burrows, and suck the juices of insects.

Fig. n. The Green Tiger-Beetle (*Cicindela campestris*) has green elytra with white markings, and the legs and undersurface of the body are coppery. It runs and flies very rapidly. An allied species (*C. hybrida*) is brown, with a greenish lustre, and more extended white spots on the elytra.



Fam. II. Carabidæ. (Ground-Beetles.) These resemble the *Cicindelidæ* in structure but their legs are shorter, and they are less active. In the typical genus *Carabus*, the head is small, the elytra convex, and the wings absent. These beetles, like many others, generally discharge an acrid fluid when touched.

Fig. l. The Gold-Beetle (*Carabus auratus*) is bright golden-green, with reddish brown legs. It is a very predacious insect, and though common on the continent, is not indigenous in England. There are however, several common British species of *Carabus*, one of which, *C. nemoralis*, is of a bronzy colour, with the thorax and elytra bordered with violet. The elytra are finely and longitudinally wrinkled. It is found at the edges of woods under moss and leaves, or running at the foot of walls.



Calosoma sycophanta, which feeds on larvæ and pupæ more frequently than on perfect insects, is one of the handsomest of the European ground-beetles, but is very rare in England. It is metallic green, with the elytra varying in lustre. It is much broader than a *Carabus*, and has fully developed wings.



Fig. m. A smaller species, not uncommon in oak-woods, is *C. inquisitor*, in

which the body is broad and nearly quadrangular; it is dark coppery above, and green beneath.

The Bombardier Beetle (*Brachinus crepitans*) has dark blue elytra and a red thorax. It is found under stones, and when disturbed, it emits a fluid, which volatilises into smoke immediately, with a slight explosion.



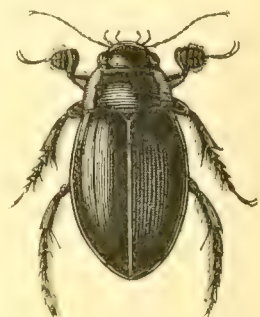
Many of the smaller *Carabidæ*, such as the species of *Feronia*, are found under stones and among dead leaves and moss in damp shady places. *F. metallica*, which is generally met with in mountainous districts, is coppery brown, with metallic green and very finely punctured elytra. The legs and palpi are reddish brown.



Amara is a very similar genus. The species are convex, with the thorax slightly narrowed in front. The legs are rather stout, and there is a spine at the end of the front tibiæ. *A. communis* is bronzy, with brown legs.



Family III. Dytiscidæ. (Carnivorous Water-Beetles.) These beetles and their larvæ live in water, and feed on insects, water-molluscs &c., and even cause much destruction to young fish. One of the commonest species, *Dytiscus marginalis*, is greenish black, with the thorax and elytra bordered with yellow.



Family III. Gyrinidæ. (Whirligig Beetles.) These, though smaller than the species of *Dytiscus*, are almost equally destructive, and may often be seen gyrating on the surface of the water. *G. natator* is blue-black, with the legs, and margins of the elytra rust-coloured. It is oval, and about a quarter of an inch long. It is represented magnified, with its larva, in the accompanying woodcuts.



Family V. The Hydrophilidæ are another family of water-beetles, in which the body is smooth and oval, and the antennæ are short and clavate. The larvæ are carnivorous, but the beetles feed chiefly on water-plants.

Fig. p. The Great Water-Beetle (*Hydrophilus piceus*) is shining black, with reddish-brown antennæ. It lives in stagnant water, but flies about in the evening. It lays its eggs enclosed in a case on the underside of a leaf in the water, and its large grey larvæ swim about in the water in June, just like fish.

Fam. VI. Staphylinidæ (Rove-Beetles.) These beetles have very short elytra, and turn up their abdomen if threatened with danger. Most of the species are of small or moderate size. One of the largest is the common black Devil's Coach-Horse (*Ocyopus olens*).



Family VII. Silphidæ. Body oval, the tip of the abdomen often projecting beyond the elytra; antennæ clavate. Both the beetles and their larvæ are very active, and feed on decaying animal and vegetable matters

Fig. k. The Burying Beetle (*Necrophorus vespillo*) is black with reddish-yellow transverse bands on the elytra, and red clubs to the antennæ. The larvæ live on carrion, and several beetles will assemble to dig away the earth under a dead mole, mouse or toad, till it sinks into the ground. They are often assisted in this work by beetles of the allied genus *Silpha*, which are shorter and broader. *S. thoracica*, here figured, has black elytra and a red thorax.



Family VIII. **Histeridæ** The body is broad and smooth, the head small, and partly overlapped by the thorax, and the antennæ clavate. The beetles live on carrion, dung &c., and if alarmed, simulate death. *Hister unicolor* is black and shining, with six striæ on the back of the elytra.



Family IX. **Nitidulidæ**. In these also the antennæ are clavate, and the legs short. The larvæ



and perfect insects of many species are found in storehouses among rice, corn &c. *Nitidula cana* is oval, the upper side metallic green or blue, and the under-surface black. The legs are blackish.

This beetle is found in abundance on the flowers of rape and turnip, and many other plants. After hibernating, they pair in May, and lay their eggs in the leaf-buds of the rape.

Family X. **Dermestidæ**.

These are small and very destructive beetles, which are to be met with wherever animal substances are to be found; in houses, larders, dovecots, under carrion, among furs, and in museums. One of the best known is the Bacon Beetle (*Dermestes lardarius*) in which the front of the elytra is brown, and the hinder part black. When touched, it contracts its legs and antennæ, and simulates death.

Family XI. **Byrrhidæ**. (Pill-Beetles.) These are roundish beetles, found among mould and carrion. *Byrrhus pilula* is clothed with brown pubescence on the upper side, and the elytra are finely striped, and marked with dusky blotches.



Family XII. **Lucanidæ**. (Stag-Beetles.) This family includes large or moderate-sized beetles, the larvæ of which feed on rotten wood. The maxillæ of the male are often enormously developed.

Fig. i. The Stag-beetle (*Lucanus cervus*) is dark brown and the maxillæ of the male are produced into long branching horns. The beetles are found in oak-woods in summer, and the larvæ feed on rotten oak.

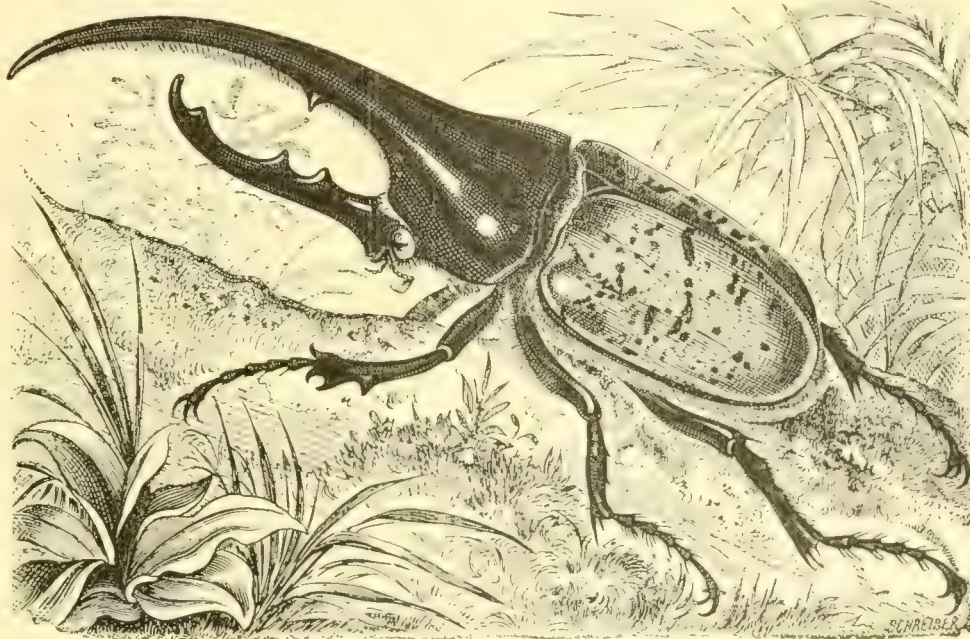
Family XIII. **Scarabæidæ**. This large family which includes the Chafers &c., may be known by the fan-like structure of the club of the antennæ. Their bodies are generally of an oval shape, and they feed on leaves or dung.

Fig. b. The Dung-Beetle (*Geotrupes stercorarius*) is blue-black, and hairy beneath. It feeds on horsedung, and flies wildly about in the evening.

Fig. d. The Sacred Beetle of the Egyptians (*Scarabæus sacer*) is black, and the head is strongly dentated in front. It is found in Egypt and Southern Europe, where it makes a ball of dung in which it deposits its eggs, and which it afterwards buries.

Fig. c. *Copris lunaris* is shining black, with striated elytra. The head is crescent-shaped, and armed with an erect horn in the male. The thorax has two depressions, and a sharp projection. It prefers cowdung.

Fig. e. There are many smaller dung-beetles, such as *Aphodius fimetarius*, which is black, with red striated elytra, and red sides to the thorax. It feeds on cowdung.



Hercules Beetle (*Dynastes Hercules*).

Fig. a. The European Rhinoceros Beetle (*Oryctes nasicornis*) is chestnut-brown, and the upper part of the head of the male is armed with a long curved horn, and that of the female with a shorter spine. The larvæ live in rotten wood, and especially in tan, in many parts

of Europe, Britain excepted.

The Hercules Beetle (*Dynastes Hercules*) is one of the largest of the South American beetles. The male is armed with formidable weapons, and has greenish-grey elytra, marked with black blotches.

Fig. f. The Cockchafer (*Melolontha vulgaris*) is black, with brown wings, a hairy thorax, and a pointed abdomen. The larva is exceedingly injurious, as it destroys the roots of grass, and the beetle feeds with equal voracity on the leaves of trees.

Fig. g. *Melolontha fullo* is a larger species, common in many parts of the Continent, though not found in England. It is brown with white markings, and the larvæ feed on leaves, especially those of the fir.

Fig. h. The Rose Chafer (*Celonia aurata*) is metallic green, with some white transverse dashes on the elytra. The larvæ live in rotten stumps, or in ant's nests, and the beetles are found on flowers in summer.



Osmoderma cremita is common on the Continent, but is not a British species. It is a dark brown, metallic-shining beetle, which lives in hollow trees. There are two prominences at the back of the thorax in the male.

Trichius fasciatus is a very hairy beetle, which is yellow, with three black spots on each side of the elytra. It is found on roses, thistles &c., creeping into the very interior of the flowers.



Family XIV. **Elateridæ**. (Click-Beetles). The body is comparatively long and narrow, and the antennæ short, and strongly serrated. There is a strong spine on the undersurface of the prothorax, which fits into a cavity in the mesothorax, and enables the beetle to leap up when laid on its back. The larvæ live on the roots of grass, or on rotten wood, and the beetles may be found among grass and flowers.

Fig. g. *Elater niger*, which is common in meadows, is black, with slightly striated elytra.

Agriotes sgeetis is reddish-brown, with brown elytra, and is found throughout the summer, and also hibernates. Its larvæ are called wire-worms, and grow very slowly, feeding on the roots of all kinds of plants.



Fam. XV. **Buprestidæ**. These beetles much resemble the *Elateridæ*, but are destitute of the leaping apparatus, and their larvæ are found under the bark of trees. They are more numerous in tropical countries than in Europe, and are often adorned with brilliant metallic colours.

Chalcophora mariana is one of the largest European species, but is not found in England. It is shining coppery above, and golden beneath. The thorax and elytra are covered with irregular raised longitudinal lines. It is found in sandy places, where its larvæ feed in the dead stumps of pine and fir trees.



Fam. XVI. **Telephoridæ**. The body is long and soft, and the elytra are leathery rather than horny. The antennæ are simple or serrated. These beetles and their larvæ are often carnivorous.

Telephorus fuscus which is common throughout Europe on the flowers of *Umbelliferae*, is clothed with fine grey hair. The thorax and belly are reddish yellow, and the elytra are greenish black. There is a black spot on the front of the thorax.



Malachius aeneus is green, with the front of the head golden yellow. The front edges of the thorax, and the elytra, except a broad green stripe on the suture, are brownish red.



Fig. t. *Lamproyris splendidula*, a common Continental species, much resembles the English Glow-worm. The winged male is brown, with the legs and the two

last segments of the abdomen yellow. The wingless female, which emits a stronger light than the male, is found among grass in summer, while the males fly about, looking like sparks in the evening.

Family XVII. **Cleridæ**. These are small beetles, which live among flowers and trees, and resemble other insects. The larvæ of some species are found in the nests of bees.

Clerus formicarius is an active little beetle, which is found on the trunks of fir-trees. The thorax is red, and the elytra are black, with the base red, and two white transverse bands.



Trichodes apiarius is a shining blue-black beetle, with bright red bands on the elytra. It is found on flowers in May and June, and feeds on other insects. Its larvæ live in the nests of bees. It is scarce in England, and is not considered to be indigenous.



Family XVIII. **Anobiidæ**. Body oval, rather soft; elytra wholly or partially closed over the body. Antennæ short, slightly serrated. The larvæ and beetles are found in dry wood.

Fig. s. The Death-Watch (*Anobium pertinax*) is a small dark brown beetle which is often found in old furniture, and makes a noise like the ticking of a watch by tapping its head against the wood. When touched it simulates death.

Family XIX. **Tenebrionidæ**. These are rather long beetles, which are active at night. The elytra are hard, and often grown together, and the antennæ are short and beadlike. In this and the four following families, the first two pairs of tarsi are five-jointed, but the hind pair has only four joints.

Fig. o. The Mealworm (*Tenebrio molitor*) is pitchy black above, and reddish brown below. Its larva is better known than the beetle.

Family XX. **Lagriidæ**. The body is long and downy. *Lagria hirta* is a soft brownish-yellow species, which is found on flowering shrubs.



Family XXI. **Pyrochroidæ**. Very like the last family in shape; the elytra are widened towards the tips. The Cardinal Beetle (*Pyrochroa rubens*) is reddish-brown, with a slender ridge on the thorax. It is found under the bark of oaks, beeches, willows &c.



Family XXII. **Mordellidæ**. These are small hairy flower-loving beetles, with the elytra suddenly narrowed, and the abdomen produced into a cone behind. *Mordella fasciata* is black, with silvery bands and spots on the elytra.



Family XXIII. **Cantharidæ**. Body long, head and thorax narrower than the elytra, which are soft, and sometimes rudimentary. Antennæ serrated or pectinated. The larvæ are parasitic on bees and humble-bees, and the beetles are found on plants.

Fig. u. The Blister-Beetle (*Cantharis vesicatoria*) is golden green and hairy. The beetle is found in trees in summer, in most parts of Europe, more or less commonly.

Fig. v. The Oil Beetle (*Meloe proscarabeus*) is bluish-back, and the male is much smaller than the female. When touched, it emits an acrid fluid from all parts of its body. It is wingless, and even the elytra are very short. It is common among grass and herbage in spring.

Family XXIV. Curculionidæ. (Weevils.) A very large group of plant-feeding beetles, with hard, elliptical bodies, and the head produced into a proboscis, on each side of which are placed the sharply-angulated antennæ. The tarsi are generally four-jointed in this and all the following families, except the last.

The Pea-Weevil (*Bruchus pisi*) is dark grey, with patches of lighter hair. The larva bores into the pods and seeds of peas, where it becomes a pupa, and subsequently emerges as a beetle. It is sometimes very destructive.

Rhynchites betule is a shining black beetle, which gnaws the young shoots of birch, beech, alder and poplar, and causes them to wither. It then forms a roll of the leaves, in which it deposits its eggs.

Fig. r. *Molytes coronatus* is a black oval species, with gilded depressed spots on the thorax and elytra. It is found under stones, or crawling slowly about walls.

The Nut-Weevil (*Balaninus nucum*) is black, thickly clothed with grey or yellowish hair. The sides of the thorax, and some irregular markings on the elytra are paler. The white larva is common in hazel-nuts.

Otiorhynchus unicolor is a shining black beetle, and the thorax is nearly as broad as long. The elytra are granulated and slightly striated. It is generally found in hilly districts.

Macrocephalus albinus is reddish brown with snow-white spots, and a broad proboscis. It feeds on rotten beeches and elms but is not often seen, as its colour resembles that of its surroundings. It is not found in England.

Family XXV. Tomicidæ. The body is long, flat and often rather narrow, and the antennæ short, with a long jointed club. The beetles and their larvæ are found beneath the bark of living trees.

Fig. j. *Bostrychus typographus*, although a small beetle, is a great destroyer of pine-forests, living beneath the bark of the trees, and there forming galleries which resemble Arabic letters. The older beetles are blackish, but those which live under the bark are brownish red before they emerge into the air.

Scolytus pruni is shining black, with the borders of the thorax and the elytra brown. It is found beneath the bark of plum-trees, which it greatly injures. Both sexes are figured, considerably magnified.

Family XXVI. Cerambycidæ. (Long-horned Beetles.) These are moderate-sized or large beetles, with rather narrow bodies and long antennæ. The head is often vertical, and the antennæ are setiform, and smooth or hairy. The thorax is often angulated at the sides. The elytra are generally long, but do

not close tightly, and are sometimes truncated. The larvæ feed on wood, but the beetles are often met with on trees and bushes. They are far more abundant in warm countries than in cold.

Cerambyx heros, which is black, with brown tips to the elytra, is one of the largest of the European species, but is not British. Its antennæ are twice as long as its body. Its larva feeds for 3 or 4 years in the interior of old oak-trees.

The beetle emerges from the pupa in July, but only flies about at night.

Rosalia alpina is black, thickly clothed with pale ashy grey pubescence. It is a very handsome beetle, which is only found in the Alps, where the larva lives in dead beech trees.

Fig. x. *Prionus coriarius* is brownish black, with a broad thorax armed with three short teeth on each side. It is found on old willows and poplars, and is much more abundant on the Continent than in England.

Fig. w. *Acanthocinus ædilis* is remarkable for its very long antennæ, which in the male are four or five times as long as the body. It is found on fallen pine-trunks, and as the larva feeds on the wood, the beetle is sometimes met with in new houses. It is found in many parts of Northern and Central Europe, including Scotland.

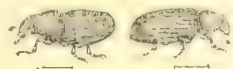
Family XXVII. Chrysomelidæ. (Golden Apple Beetles.) Body oval, longer than the filiform antennæ. The larvæ feed on the leaves of various plants.

Fig. y. *Crioceris merdigera* is black, with red thorax and elytra. It is fond of the white lily.

The Colorado Potato-Beetle (*Leptinotarsa decemlineata*) is reddish yellow, with the tips of the antennæ and the legs black. The elytra are yellow with black stripes, and the wings are red, a very unusual character in a beetle. The beetle is indigenous in the Rocky Mountains of North America, where it feeds on wild *Solanaceæ*, but of late years has attacked the potato, and spread over the whole of the United States. The larva feeds on the leaves of the potato, and after three weeks, buries itself in the ground to become a pupa.

Family XXVIII. Coccinellidæ (Lady-Birds). The body is round, convex above, and flattened beneath. The antennæ are short and filiform, and the tarsi three-jointed. Both the beetles and their larvæ feed on plant-lice (*Aphides*).

Fig. z. The Seven-spot Lady-bird (*Coccinella septempunctata*) is abundant everywhere. It is black, and the elytra are red, with seven black spots. When touched, it emits a dark yellow fluid. Sometimes it migrates from place to place in vast swarms.



Order II. Hymenoptera.

Plate XXV. (left side).

Mandibulate insects, with complete metamorphoses, and two pairs of veined wings, differing in size. There are always five joints to the tarsi. There are three simple eyes (ocelli) placed in a triangle, on the top of the head. The three principal divisions of the body are usually connected together by slender stalks, and the female is either provided with an ovipositor, or with a sting communicating with a poison-gland. The *Hymenoptera* live on various animal and vegetable substances, and lay colourless eggs. The larvæ are generally footless and inactive, except in the *Tenthredinidæ*. Some species live in nests in large communities, and thus rear their young. The honey-bee has been domesticated from the earliest times.

Section I. Hymenoptera Terebrantia.

Boring *Hymenoptera*.

In these, the female is provided with an ovipositor which she employs to lay her eggs upon plants, or in the bodies of other insects.

Family I. *Tenthredinidæ*. The Saw-flies are sluggish insects, with a broad head, compressed body, with no marked division between the thorax and abdomen, and a straight or curved saw in a sheath beneath the extremity of the abdomen in the female. They feed on the leaves of various plants, and some produce galls on willows. Their larvæ resemble caterpillars, but have from 18 to 22 legs; true caterpillars have never more than sixteen.

Fig. a. *Hylotoma rosæ* is a species which feeds on rose-leaves. The larvæ are green with rows of black spots, and form double cocoons, in which they change to pupæ.

Fig. b. *Lophyrus pini*. The male is black, and the female, which is larger, is yellowish. The green larva is very destructive in pine-forests. It passes the winter in a white cocoon.

Fig. c. *Trichiosoma betuleti* is one of the largest species. It is black, with reddish abdomen. The fullgrown larva is bright green, with white warts scattered irregularly over it, and a yellow head. It eats the leaves of the birch, and becomes a pupa in a brown barrel-shaped case, fixed to a branch.

Family II. *Siricidæ*. The Wood-wasps resemble the Ichneumons in the long ovipositor of the female, but their abdomen is continuous with the thorax, and not contracted at the base.

Fig. d. *Sirex gigas* is black, with part of the abdomen yellow. It bores through the bark of the pine-tree with its ovipositor, and deposits an egg in the cleft. When the larva is hatched, it eats a gallery into the interior of the tree, and there becomes a pupa.

Family III. *Ichneumonidæ*. These insects differ much in form, but the females all possess a long ovipositor enclosed in a double sheath. With this, they lay their eggs in the larvæ of other insects, or in their eggs or pupæ. They are very numerous in species, and many are adorned with brilliant colours.

Fig. e. *Anomalon circumflexum* has a dark-coloured head and thorax, and a yellowish-red abdomen, tipped with black. This species attacks and destroys the larvæ and pupæ of the large pine-tree moth, *Entricha pini*.

Fig. f. *Pimpla manifestator* is black, with reddish yellow legs. It seeks out larvæ and pupæ in the most retired hiding-places.

Family IV. *Braconidæ*. These are distinguished from the *Ichneumonidæ* by their having fewer veins in the wings.

Fig. g. *Microgaster glomeratus* is shining black, with the belly and the greater part of the legs reddish yellow. It is specially destructive to the caterpillars of the white butterflies.

Family V. *Cynipidæ*. The Gall-Flies are small hump-backed insects, with a short stalked oval or raised and laterally compressed abdomen, filiform antennæ, and a rather prominent sheath, containing a long ovipositor. The wings are as long or longer than the body, but are sometimes absent in the females. They are generally black or brown, and tolerably uniform in colour. The females lay their eggs under the cuticle of various leaves or stalks, which gives rise to galls, which are hard or spongy excrescences in which the larvæ live either singly or in numbers. Some form their pupæ in the galls, and others outside. Ink is prepared from some kinds of oak-galls found on the shores of the Mediterranean. The flies only live a short time, and take no food.

Fig. h. *Cynips scutellaris* produces the round fleshy oak-apple found on the undersurface of oak-leaves. The fly has a shining black abdomen, and reddish brown head and legs.

Fig. i. *Rhodites rosæ* has a broad black head, and reddish brown legs and abdomen. The thorax is black. It produces the moss-like gall called bedeguar on dog-roses.

Section II. Hymenoptera Aculeata.

Stinging *Hymenoptera*.

The female is provided with a sharp sting.

Family VI. *Chrysididæ*. The Ruby-tail Flies are small hump-backed insects which can roll themselves into a ball by turning the abdomen beneath the breast. The antennæ are angulated, and the ovipositor short, but strong. The larvæ live as parasites in the nests of wasps and bees.

Fig. k. *Chrysis ignita* is one of the commonest species. The thorax and the first segment of the abdomen are bright metallic blue, and the rest of the abdomen shining golden. It lays its eggs in the nests of wall-bees, and fossorial wasps.

Family VII. *Sphegidæ*. These are slender wasps with a long stalked abdomen, and spiny hind tibiæ. They lay their eggs in holes, along with a store of caterpillars or spiders, which they have disabled with their sting, to serve as food for the young larvæ.

Fig. l. *Ammophila sabulosa* is black, with a red ring round the abdomen, which is long and stalked, and the mouth is produced into a sort of proboscis.

Fig. m. *Trypoxylon figulus* is a slender black insect, which bores holes in wood, which it lines inside with clay.

Family VIII. *Pompilidæ*. These insects dig holes in the ground, and provision them with caterpillars for their young. Sometimes, too, they store up flies and other insects instead.

Fig. n. *Pompilus viaticus* is usually met with on sunny pathways. The body and tips of the wings are black, and the abdomen red, with a black ring at the end of each segment.

Family IX. *Formicidæ*. The Ants have angulated antennæ, and a slender body, with the prin-

cipal divisions well marked. They are very active and energetic, and generally live in large communities, consisting of males, females, and neuters, or imperfectly-developed females. The neuters are always wingless and perform the work of the nest, and the males and females only retain their wings for a short time. They secrete a substance called formic acid, which serves them for purposes of defence. They are omnivorous, feeding on all kinds of animal and vegetable substances, and especially on the sweet substance called honey-dew, which is produced by Aphides. The so-called "ant's-eggs" used as food for birds, are the pupæ. In cold countries ants hibernate, but in warmer climates many species lay up large stores of seeds or leaves in their nests.

One of the largest European ants is *Camponotus herculeanus*, which is common on the Continent, especially in hilly districts, where it makes its nests under old trees (*a* worker, *b* male, *c* female).

Fig. o. *Formica rufa*. The Wood Ant makes large mound-like nests in woods, especially in fir-woods, and destroys large numbers of other insects.

Family X. The **Vespidæ**, or Wasps, are stinging insects, in which the fore wings are longitudinally folded when at rest, giving then the appearance of being narrower than they really are. They have a broad head, short antennæ, and strong jaws. During summer, they live in nests constructed of a paper-like fabric formed of comminuted wood, where they rear their larvæ, which they feed with honey or dead insects. They also feed on juicy fruit. The males, females and neuters are all winged.

Fig. p. *Odynerus parietum* is black, with two yellowish red spots on the thorax, and four yellow stripes on the abdomen. It lays its eggs in a tube formed of earth and sand.

Fig. q. *Vespa vulgaris*, the common wasp, forms its nest in the ground, and less frequently, in trees. Most of the wasps perish in autumn, but a few females survive the winter, and found new colonies.

Fig. r. *Vespa crabro*. The Hornet builds its nests in trees or under rafters. It is larger than the other European wasps, but lives in smaller communities.

Family XI. **Apidæ**. The bees may generally be recognised by their stout compact hairy bodies. They have short, strong legs, short antennæ, and moderately long wings. They live on the honey of flowers, which some of them store in their nests. They live singly or in communities, and the intelligence of the social bees is not greatly inferior to that of the ants. Their sting is painful, like that of the ants and wasps.

Fig. s. *Apis mellifica*. The Honey Bee has the first joint of the hind tarsi shovel-shaped, and furnished with a brush. This apparatus enables it to collect the pollen of flowers. It also collects the honey with its broad tongue, and on reaching the hive, disgorges it into the waxen cells prepared for its reception. Bees are reared in all parts of the world for the sake of their

wax and honey, in receptacles called hives, where they build their nests. Each hive contains from 12,000 to 30,000 bees. The nests consist of cells of wax, placed close together, and are divided into layers with passages between. These cells serve as nurseries for the young brood, and as receptacles for the honey. There is only one egg-laying female in each hive, which is called the queen. There are a few hundred males, or drones, which idle away the summer, but are all killed by the workers on the approach of winter. It is the workers which not only collect pollen, wax and honey, but also feed the larvæ and the queen. If the queen is lost, the whole hive is liable to perish. Every year, several queens are produced, when they fight until one is killed. At other times, one of them leads a colony from the hive, and establishes herself elsewhere; and this is called swarming. In the winter the bees cease their work, and feed on their stores, close the hive except a small opening, and do not reappear till spring.

The genus *Bombus* contains the Humble Bees, which are larger than the Hive Bees. They live in small communities, forming their nests in holes in the ground. There are large and small females, large workers, and small males among them. They collect honey and pollen, and work like bees. In autumn, they all die, except some of the large females, which found next years' colonies.

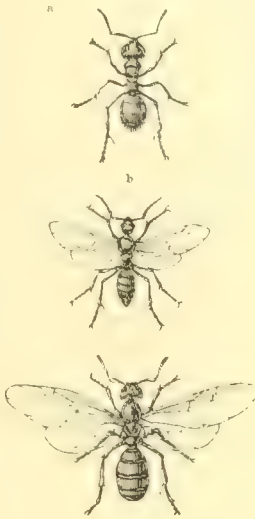
Fig. t. *Bombus lapidarius* is a black species, with the extremity of the body red.



Queen bee.



Worker.



Bombus terrestris is one of the commonest Humble Bees. It is banded with black and yellow, and the tip of the abdomen is whitish. The parent bee chooses a hole in the ground, perhaps that of a field-mouse, and hollows out a cavity where it forms cells in which it lays eggs which produce white maggots. These are fed by the mother with clear honey, and after passing through the pupa state, emerge as small females, and take their share in the work of the nest.



Drone.

Order III. *Lepidoptera*. (Butterflies and Moths.)

The *Lepidoptera* have a long body, a spiral tube through which they suck their food, and which is placed between the movable palpi, and four large wings, covered with scales, and of varied colours and markings. The antennæ are moderately long, and of different shapes. The eyes are large, and ocelli, or simple eyes, are also frequently present. There are six legs, sometimes unequally developed. They feed chiefly on the honey of flowers. They only live a short time, and many are destroyed by birds and bats.

Lepidoptera lay eggs, which produce caterpillars provided with from 5 to 8 pairs of legs. Caterpillars may be smooth, hairy, bristly, or spiny &c. They feed on leaves, and are often very destructive. The pupa is incapable of movement or feeding.

Section I. *Rhopalocera*. (Butterflies.)

Butterflies have broad wings, generally of bright colours, and a knob at the end of the antennæ. They fly by day. The larvæ always have 16 legs, and the front legs of the perfect insect are frequently shorter than the others.

Plate XXV (right side).

Family I. *Nymphalidæ*. The butterflies of this group are of large or moderate size, and of rich dark colours. The first pair of legs is imperfectly developed. The pupa is suspended by the tail, and the caterpillars are either spiny, or provided with a forked tail.

Fig. l. *Erebia Medea*, the Scotch Argus, is our commonest British representative of a genus of butterflies of very similar colours, which are more numerous on the Continent than with us. They are almost confined to mountainous regions, and no species are met with in the South of England.

Fig. m. *Epinephile Janira*, the Meadow Brown, is one of our commonest butterflies in the fields at haymaking time.

Fig. k. *Melanargia Galathea*, the Marbled White, on the other hand, though common where it occurs, is a local insect with us. The three butterflies just mentioned have smooth caterpillars with forked tails, which feed on grass.

Fig. a. *Melitæa Cynthia*. The Fritillaries are reddish butterflies with black markings on the upper surface, and pale chequered markings beneath. The species figured is remarkable for the white spots on the upper surface of the male; it is found in the Alps in June and July.

Fig. b. *Argynnis Paphia*, the Silver-washed Fritillary, is one of our handsomest butterflies, and not uncommon in some places in woods in summer. The species of *Argynnis* differ from those of *Melitæa* in having silvery markings on the undersurface of the wings; and in *A. Paphia* the hind wings are adorned with three silvery stripes.

Fig. c. *Argynnis Lathonia*, the Queen of Spain Fritillary, is rare in the South of England in autumn. The hind wings are covered with large square silvery spots. In other spotted species of *Argynnis* the silver spots are round, and much smaller. The caterpillars of the Fritillaries are spiny, and feed on various low plants, especially violets.

Fig. d. *Pyrameis Atalanta*, the Red Admiral, is common in gardens in autumn. The caterpillar feeds

on nettles, spinning some of the leaves together. The pupa is ash-coloured, with gilded spots.

Fig. e. *Vanessa Io*, the Peacock Butterfly, is often found in lanes in summer, where the black caterpillar feeds on nettles.

Fig. f. *Vanessa Antiopa*, the Camberwell Beauty, is rare in England, and is more in the habit of feeding on ripe fruit than the other species of *Vanessa*. The larva feeds on poplars and willows.

Fig. g. *Vanessa Polychloros*. The Large Tortoise-shell Butterfly is met with in the South of England on the borders of woods; the caterpillar feeds on willows, elms &c.

Fig. h. *Vanessa urtica*. The Small Tortoise-shell is one of the commonest species of the genus in gardens, woods &c., and the caterpillar feeds on nettle. The larvæ of *Pyrameis* and *Vanessa* are spiny, and the butterflies (except *Pyrameis Atalanta*, which is rarely seen before June at the earliest) hibernate, and are to be found throughout the fine part of the year. In fact, in very mild seasons, an occasional specimen of *Vanessa urtica* may be noticed on the wing during almost every winter month.

Fig. i. *Apatura Iris*, the Purple Emperor, the largest of the British *Nymphalidæ*, may be seen at Midsummer flying round the tops of trees (especially oaks) in woods in the South of England. The caterpillar is green, with oblique yellow lines, and two horns on the head; it feeds principally on sallow.

Family II. *Lycanidæ*. These are small butterflies, blue, copper-coloured or brown, with eye-like spots or white lines on the undersurface. The front legs are imperfectly developed in the males. The caterpillars are oval, somewhat resembling woodlice in shape, and the pupa is attached by the tail, and by a belt of silk round the body.

Fig. n. *Lycæna Icarus*, the Common Blue, varies a little in size and colour, but may easily be recognised by the white fringes to the blue wings. The female is blue or dark brown, with a row of red spots on the margins of at least the hind wings. The underside is brownish grey, bluish towards the base, and marked with several round black spots in white rings. The larva feeds on clover.

Fig. o. *Chrysophanus virgaureæ*, the Scarce Copper, may be known by its intense copper-colour, and by one or two white markings on the undersurface of the hind wings, which no other European species of the genus exhibits. It is an extremely rare species in England, so rare, in fact, that it is hardly reckoned among our indigenous British butterflies. The larva feeds on Golden Rod.

Fig. p. *Thecla Petula*, the Brown Hairstreak, is found in autumn in the South of England and Ireland in woods and along hedges, but is not a very common species. The male is brown, hardly exhibiting a trace of the orange blotch on the fore wings shown in our figure of the female. The underside is dull orange, with a brownish band, edged on both sides with white lines. The caterpillar feeds on sloe.

Family III. *Papilionidæ*. These are white or yellow butterflies, of large or moderate size. They have six perfect legs, and the pupa is attached by the tail, and a belt round the body. In the first two genera, the inner margin of the hind wings is

concave, and the caterpillars have a retractile fork on the neck; in the others, the inner margin of the hind wings forms a kind of gutter to receive the abdomen, and the larvæ have no fork on the neck.

Fig. q. *Papilio Machaon*, the Swallow-Tail, is one of the largest of the European butterflies. Although common on the Continent, it is now only found in England in the fenny districts of the South-eastern countries. The green caterpillar with black bands and orange spots feeds on umbelliferous plants.

Fig. r. *Papilio Podalirius*, the Scarce Swallow-Tail, is a woodland insect, and its green, red spotted caterpillar feeds on sloe, and various other trees. This insect is now extinct in England.

Fig. s. *Parnassius Apollo* is a common Alpine butterfly, but is not British; the caterpillar is black, dotted with blue and yellow, and feeds on saxifrages.

Plate XXVI (left hand).

Fig. a. *Pieris brassicæ*, the Large White Cabbage Butterfly, is common everywhere, and its green caterpillar is very destructive to all kinds of cabbage. The female butterfly differs from our figure of the male in having two black spots on the fore wings, and a streak on the inner margin.

Fig. b. *Colias Hyale*, the Pale Clouded Yellow is scarce in England, though one of the commonest of autumn butterflies on the Continent. We have figured a female; the male is of a more sulphur-yellow colour. The green caterpillar feeds on clover.

Fig. c. *Gonepteryx Rhamni*, the Brimstone Butterfly, is common in woods both in spring and autumn. The female is of a whitish-sulphur colour. The green caterpillar feeds on buckthorn.

Family IV. **Hesperiidæ**. The Skippers are small brown, black and white, or tawny butterflies, with six perfect legs, a large head, with the antennæ, which are generally hooked, placed widely apart, and short wings. The caterpillars change to pupæ between leaves.

Fig. d. *Thymelicus Thaumias*, the Small Skipper, is tawny, with brown borders, and there is a black streak on the fore wings of the male. It is common in meadows in July and August, and the green caterpillar feeds on grass.

Fig. e. *Erynnis Alceæ* is a dull-coloured and rather variable butterfly, which is found in grassy places in many parts of the Continent, but not in England. Its grey caterpillar feeds on mallow.

Section II. Heterocera. (Moths.)

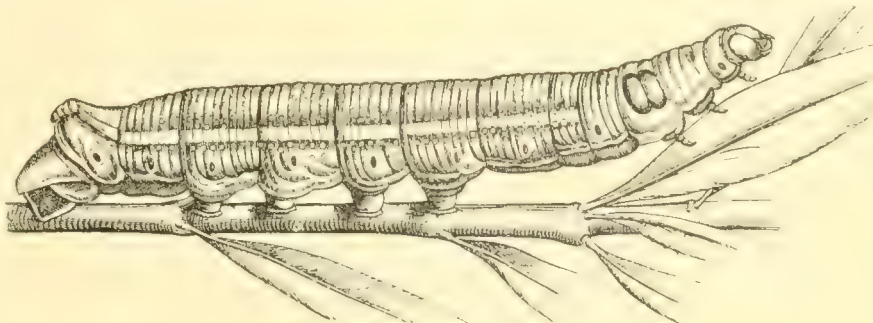
The Moths vary much in structure and habits. The antennæ are variously formed, but are never

knobbed at the extremity, as in the butterflies; and many of the species are of dull colours, and fly at dusk or at night. The larvæ have from 10 to 16 legs; and the front legs of the perfect insects are fully developed. The first four families are called Sphingides, and the following seven families are called Bombyces, but have fewer characters to justify their being classed together than the succeeding groups of *Lepidoptera*.

Family I. **Sphingidæ**. (Hawk-Moths.) These are large or moderate-sized moths with thick bodies, narrow wings, large eyes, and spindle-shaped, and frequently serrated, antennæ. They hold their wings horizontally or sloping, and fly rapidly at dusk, or at night, and a few species fly by day. The larvæ are naked, or thinly haired, and are generally provided with a fleshy horn at the extremity of the back. They feed on low plants, or on trees, and undergo their transformations in the ground, or in a slight cocoon on the surface.

Fig. f. *Smerinthus ocellatus* is a very beautiful

and not uncommon species. The caterpillar is bluish green with white dots and lines, and feeds on willow, apple, and other trees. The species of *Smerinthus* differ from the other *Sphingidæ* in having a short proboscis, dentated



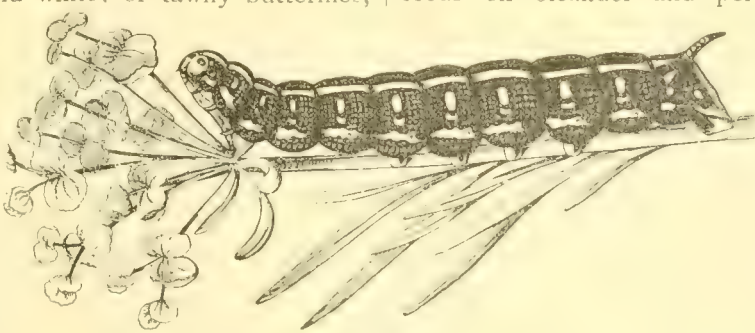
Larva of Oleander Hawk-moth.

wings, and a very heavy flight.

Fig. g. *Smerinthus Populi*, the Poplar Hawk-moth, is perhaps the commonest of the larger *Sphingidæ*. The green larva with yellow oblique lines is often met with on poplar.

Fig. h. *Daphnis Nerii*, the Oleander Hawk-moth, is abundant in Africa and Southern Asia, but is only a rare and casual visitor in warm summers in Central and Northern Europe. The caterpillar is green, with a whitish stripe on the sides, and feeds on oleander and periwinkle.

Fig. i. *Charocampa Elpenor*, the Elephant Hawk-moth, is a much commoner insect. It derives its name from the structure of the caterpillar, which has the front of the body narrowed and retractile (as has also that of *Daphnis Nerii*) which has been fancifully thought to give it some



Larva of Spurge Hawk-moth.

resemblance to an elephant's trunk. This caterpillar, which is either green or brown, feeds chiefly on willow-herb.

Fig. k. *Deilephila Euphorbiæ*, the Spurge Hawk-moth, is common on the Continent, but very rare in England. The caterpillar, which generally feeds on spurge growing in exposed places, is very beautifully coloured. It is very dark green, with white dots, and bright red lines on the back and sides. There is a large yellow spot on each segment, and a smaller white dot beneath it. It forms its pupa underground, or among leaves.

Fig. l. *Sphinx Ligustri*, the Privet Hawk-moth, is a very common species. The caterpillar is pale green, with seven oblique violet-blue stripes on each side, bordered with white below. When at rest, it sits up in a posture which has been imagined to resemble that of an Egyptian Sphinx, and this is the origin of the name now given to the whole family. Its favourite food is privet, but it is sometimes found on other trees.

Fig. m. *Sphinx Convolvuli*, the Unicorn Hawk-moth is an autumn insect, and is uncertain in appearance, being much commoner in some years than in others. The caterpillar, which is brown or green, may be met with on the ground, hidden under bindweed. When weeds were allowed to grow more freely, it used frequently to be found on bindweed growing among corn in England. The moth is remarkable for the great length of its proboscis.

Fig. n. *Acherontia Atropos*, the Death's Head Hawk-moth, is the largest moth found in England. It has derived its name from the curious markings on the back of the thorax, which have some resemblance to a skull. The caterpillar is yellowish green, and feeds on various plants, but in England is generally found on potato. It is never common enough to do any real harm; but the large dark reddish-brown pupa is often dug up in potato-fields in autumn.

Fig. o. *Macroglossa stellatarum*, the Humming-Bird Hawk-moth, flies very rapidly over flowers by day, in the manner of a humming-bird; it is remarkable for its tufted abdomen. The green caterpillar feeds on bedstraw. In some allied species found in woods in spring, the wings are transparent, with reddish-brown borders.

Family II. *Ægeriidae*. These are small moths, with long tapering and generally tufted bodies, spindle-shaped antennæ, ending in a tuft of scales, transparent wings with opaque borders; and yellow or red belts on the abdomen. They fly by day, and the larvæ are white, naked, and maggot-like, and live in the wood or in the roots of trees and plants.

Fig. p. *Ægeria apiformis* is the largest species of this family, and may often be seen in early summer sitting low down on the trunks of poplars, and looking very like a hornet. The larva feeds in the roots and trunks of poplars.

Fig. q. *Trochilium formicæforme* is a smaller and scarcer species, which feeds on willows.

Family III. *Anthroceridae*. These are small brightly coloured moths, with thick spindle-shaped antennæ, curved at the tip. The wings are sloping, and the fore wings are spotted. The larvæ are cylindrical, and finely hairy; they feed on low plants, and form narrow boat-shaped parchment-like cocoons attached to the stalks of grass &c. The moths fly by day.

Fig. r. *Anthroceræ filipendulæ*, the Six-spot Burnet, is the commonest species in England. It is often to be found in meadows in abundance, flying over the tops of the herbage, or resting on grass and flowers; perhaps several together on a large flower like a thistle. The caterpillar feeds on clover &c.

Fig. s. *Anthroceræ carniolica*, which is common in many places on the Continent, differs from any British species in having the spots bordered with white. The caterpillar feeds on milk vetch, and other low plants.

Plate XXVI (right hand).

Family IV. *Hepialidae*. The antennæ are short, and the wings long, and widely separated at the base. The moths fly in meadows after sunset.

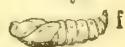
Fig. a. *Hepialus humuli*, the Ghost Moth. The male is white above and brown beneath, but the female has yellowish fore wings with red markings, and dull reddish hind wings. The caterpillar is yellowish white, with black warts, and a brown head. It feeds on the roots of hop, nettle &c. It forms an oval cocoon with particles of earth at the roots of plants, and after a few days, the moth emerges. It has a peculiar hovering flight, and is often abundant in June and July.

Family V. *Zeuzeridae*. The proboscis is absent, the wings strong, and the female is provided with an ovipositor. The larvæ are smooth, with short scattered hairs. They feed in the wood of trees.

Fig. b. *Zeuzera æsculi*, the Wood Leopard Moth, is not very scarce in the suburbs of London. The caterpillar is yellow, with small raised black dots, on which hairs are placed, and feeds in the young shoots and branches of trees, especially in young apple and pear-trees, which it sometimes destroys, though it is seldom sufficiently abundant in England to cause very serious injury. The larva lives in the trees for two years, when it emerges from the pupa, which projects from the bark, in July and August.

Family VI. *Psychidae*. The males of these curious little moths have strongly pectinated antennæ and hairy bodies, but the black or grey wings are only thinly clothed with scales.

The females are apterous, with a small head and thorax, and a large, nearly naked abdomen. The larvæ resemble those of caddisflies, for they live in a cylindrical tube, or in a case, which they construct immediately on quitting the egg, from fragments of grass, stalks, bark, particles of earth &c., and which they enlarge as they grow. The cases are found on trees, grass, or rocks, generally in places sheltered from the wind. One of the largest European species is *Psyche unicolor*, which, however, is not found in England. It has black wings with white fringes, strongly pectinated antennæ, and the head, thorax and abdomen clothed with rough hair. The insect is represented of the natural size in its various stages in the accompanying figures, as follows: a male, b female,



c female pupa, seen from beneath, *d* closed case of female, *e* case of male, showing larva, *f* pupa of male.

Family VII. Saturniidae. Large broad-winged moths, with short, stout, hairy bodies, and with the antennæ of the male strongly pectinated. In the middle of each wing is a large eye-like spot composed of rings and crescents of various colours, which is often replaced, in foreign species, by a round, triangular or crescent-shaped transparent spot.

Fig. *c*. *Saturnia pyri*, the Great Peacock Moth, is the largest of the European moths. On the under-surface, it is pale grey as far as the zigzag line, and then brown; the markings are nearly the same as on the upper surface, but paler. The appearance of the larva changes at each moult, and the full-grown caterpillar is yellowish green with blue hair-bearing warts. This fine moth is found in the South of Europe, where the caterpillar feeds chiefly on fruit-trees, as far north as Paris and Vienna. A smaller but somewhat similar insect, the Emperor Moth, is not uncommon in England. Its green larva with red tubercles feeds on heath.

Fig. *d*. *Agria Tau*, the Tau Emperor, may be known by the large round blue spot on each wing, with a white T-like mark in the middle. The female is larger and paler than the male, which flies wildly about in woods in spring, and is very difficult to catch. The pale green caterpillar feeds on beech, birch and lime, and is adorned with stiff movable spines when young, which it casts off at the third moult. It changes in the ground under moss to a rough pupa, covered with little hooks, and enclosed in a rough cocoon. It is a common insect on the Continent, but is not British.

Attacus Cynthia, the Ailanthus Silk-worm Moth, belongs to the same family. It has satiny olive-green wings, with pink and white stripes and bands, and a transparent lunule, partly bordered with yellow. There is also a small blue white-bordered eye-spot near the tip of the fore wings. The full-grown larva is green with fleshy tubercles. Its natural food is *Ailanthus glandulosa*, but it will eat other trees. The moth is a native of the East Indies, but is often reared in Europe.

Family VIII. Lasiocampidæ. These are large dark-coloured moths, with no eye-spot on the wings. The abdomen is thick, hairy, and rather long. The antennæ of the male are strongly pectinated, and the caterpillars are hairy.

Fig. *e*. *Gastropacha quercifolia*, the Lappet Moth, has some resemblance to a dead leaf. When at rest, the fore wings are sloped over the body,

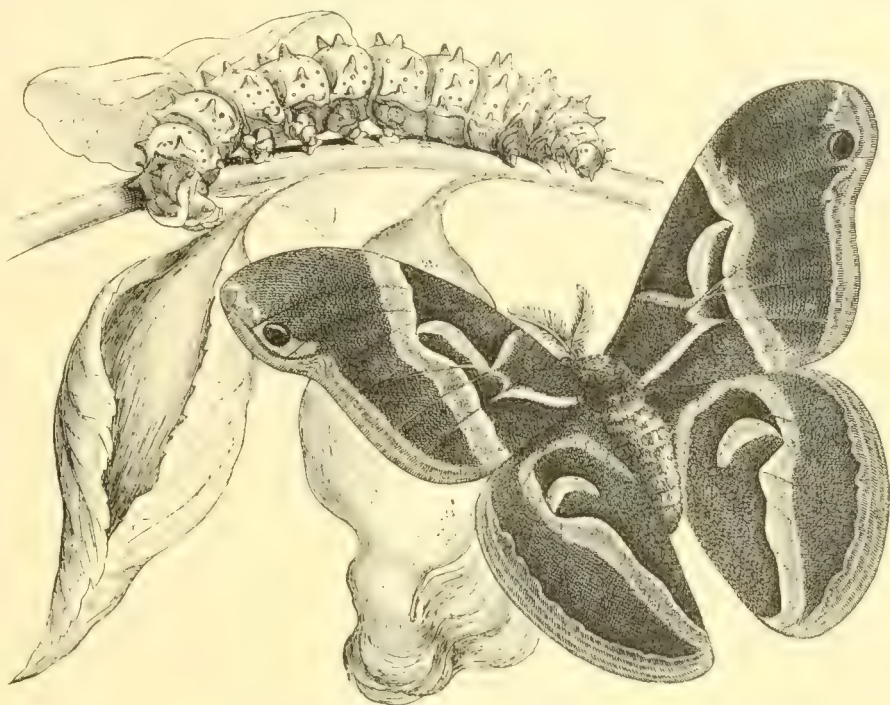
and the zigzag border of the hind wings projects beyond their edges. The brown larva feeds on various trees in May, but only at night. It becomes a pupa in an oval dark grey cocoon covered with whitish dust.

Fig. *f*. *Clisiocampa nevustria*, the Lackey Moth, is one of the most destructive insects to fruit and forest-trees. It is pale ochre-yellow, or reddish, with two brown stripes on the fore wings. The female lays her eggs in a ring round a small branch. The caterpillars hatch in the spring, and live together for a long time in a silken nest, to which they resort at night, and which renders it easy to destroy them in this stage. When they are older, they separate, and then spin themselves a cocoon between leaves.

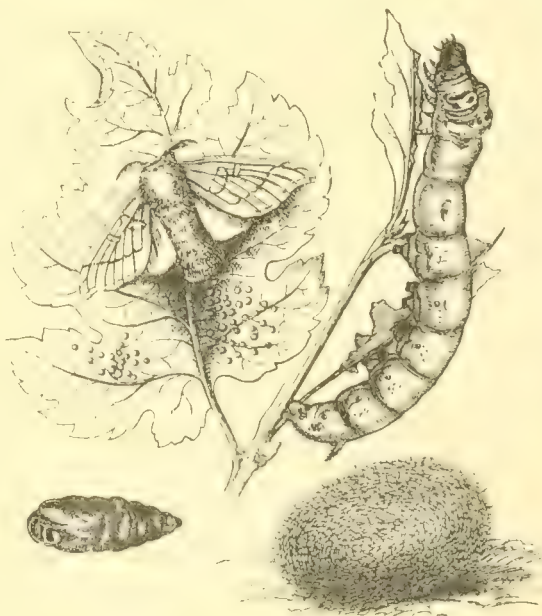
Family IX. Bombycidæ. The wings are emarginate, and the antennæ of the male are pectinated.

The larva is naked, and provided with a horn, like a *Sphinx*.

Bombyx mori, the Mulberry Silkworm moth, is of a dirty white, with darker lines. The female lays from 200 to 300 eggs, and the caterpillars feed on mulberry leaves, until they form their cocoons, and change to pupæ. They make white or yellow cocoons of a single thread which may measure as much as 600 feet in length. This is secreted by two long slender cavities which open in a narrow tube at the mouth.



Ailanthus silk-worm, with cocoon and moth.



Silkworm, with pupa, cocoon and moth.

The liquid secretion hardens into a thread as soon

as it is drawn out into the air. This forms a loose web at first, but gradually contracts into an oval case. The cocoons are prepared in the following manner: The cocoons are either put into an oven, or exposed to hot steam to kill the pupæ. After the looser threads (the floss-silk) has been separated, the cocoons are thrown into boiling water. The inner silk is then loosened with a rod, and as soon as the end of a thread is caught, the rest can easily be reeled off. Afterwards the silk is spun and woven into threads. The natural colour of the silk is white, yellow, greenish, or isabelline; and all others are dyed. A pound of silk is worth about twenty-four shillings, and North Italy alone annually exports silk of the value of upwards of £ 4,000,000. The silk-worm is a native of China, but is now reared in all the warmer parts of the world.

Family X. **Notodontidæ**. The fore wings are longer and thicker than the hind wings. The abdomen is stout, and the legs are short and thick, and all of equal length.

Fig. g. *Cnethocampa processionea* derives its name from the habits of its larva, the Processionary Caterpillar. In some seasons, they increase so much as to defoliate the oak-forests on the Continent, and to kill many of the trees. The bluish-black caterpillars with long whitish hairs on the sides, pass the day in large nests of web, and march out in the evening to feed in pyramidal order. They are usually found only on oaks, but will also feed on other trees. They afterwards return to the nest in the same order, one larva heading the procession. They are not only injurious from their voracity, but by casting their hairs, which cause intolerable itching and painful swellings if they come in contact with the skin. The yellowish grey moth with darker markings is found in autumn, and lays about 200 eggs on the trunk of a tree. It is unknown in England.

Fig. h. *Phalera Bucephala*, the Buff-tip Moth, is common and destructive in most parts of Europe. The hairy caterpillar is black with yellow longitudinal streaks interrupted by reddish belts, and is found on a great variety of trees from July to October; and the moth emerges early in the following summer.

Family XI. **Liparidæ**. These are white or brown moths with short, broad wings, short antennæ, pectinated in the male, and a tuft at the end of the abdomen in the female with which they cover their eggs. The larvæ are hairy, and often injurious.

Fig. i. *Ocneria dispar*, the Gipsy Moth, differs so much in the sexes that no one would imagine them to be the same. The male, which is represented in our figure, is brown, with pectinated antennæ, and flies about in the sunshine. The female is much larger, and is white, with zigzag blackish lines, and a thick abdomen covered with yellowish-grey wool. The antennæ are black, and but slightly pectinated. The moths appear in summer, and the female, which is generally seen sitting on the trunks of trees, lays from 300 to 500 eggs, which it covers with wool from its abdomen. In the spring, the caterpillars hatch, and are very destructive to the trees on which they feed. About Midsummer, they form their cocoons in a leaf.

Family XII. **Arctiidæ**. These moths are generally adorned with bright colours; and the antennæ are more or less pectinated in the males. The caterpillars feed chiefly on low plants, and are very hairy.

Fig. k. *Arctia Caja*, the Tiger Moth, is very common in gardens. The black hairy caterpillar is

sometimes called the Woolly Bear. It creeps very fast, and if touched, rolls itself up like a hedgehog. It feeds on all sorts of low plants, and is not particular about its food.

Fig. l. *Callimorpha hera*, the Jersey Tiger, is another handsome species; but though common on the Continent, it is very scarce in England. The caterpillar is greyish brown, with a yellow stripe on the back, pale yellowish-white lines on the sides, and yellow warts. It feeds on low plants and shrubs.

The **Noctuæ**, or nocturnal moths proper, have a thick body, pointed behind, broad and generally sloping wings, generally of dull colours, and the hind wings shorter, more slender, and often without markings; the antennæ are rarely pectinated, and the legs are long. The caterpillars are naked, or thinly clothed with hair, and have from 12 to 16 legs. The pupa is naked and generally subterranean.

Fig. m. *Panolis piniperda* is a handsome moth of moderate size which is sometimes injurious in pine and fir-forests. The caterpillar is green with 3 white lines on the back, and a yellow one on the sides.

Fig. n. *Mamestra brassicae*, the Cabbage Moth, is a dark brown moth, with some white specks on the fore wings. Late in autumn, after the caterpillars of the white butterflies have disappeared from the cabbage-fields, holes are frequently seen in the leaves, but the caterpillars are not visible by day, as they hide themselves in the ground, and only feed at night. After moulting four times, they attain their full size in three or four weeks, when they eat their way deeper into the cabbages. Then they burrow in the ground, and presently change to pupæ, in which state they pass the winter, and emerge as moths in May. The female lays her eggs which hatch in a fortnight, singly on the cabbages, and the moths from this brood appear at the end of the summer.

Fig. o. *Mamestra pisi* is reddish brown, with dark transverse lines on the fore wings, and a white zigzag line towards the hind margin; the hind wings are ashy grey. The moth is found in May and June, and is not rare. The larva is green or brown with yellow lines. It feeds on peas, beans, clover, and other garden-plants, and sometimes causes considerable damage. In autumn, it makes a slight cocoon in the ground, and the moth appears in the following May.

Fig. s. *Triphaena Pronuba*, the Yellow Underwing, is another very common moth in gardens and hayfields in June and July. The caterpillar is yellowish brown, with dark oblique dashes on the sides. It feeds on low plants at night, hiding itself under leaves during the day.

Fig. p. *Plusia Gamma*, the Gamma Moth, is one of the commonest of all the European **Noctuæ**, and in some seasons it is excessively abundant. It may be seen at all hours of the day and night sucking honey from all kinds of flowers, and has a wild swift flight. The female lays her eggs on the upper surface of the leaves, and the caterpillars hatch in about a fortnight. They feed on flax, hemp, peas, beans, cabbages, clover, and many other plants, devouring the leaves, flowers and young seeds indiscriminately. The fore wings are varied with violet-grey and brownish-grey, and are ornamented with a silvery white mark resembling a y, or more nearly, the Greek letter γ, from which the moth derives its name. Sometimes, however, it is called the Silvery Moth.

Fig. q. *Catocala fraxini*, the Clifden Nonpareil, is the largest of the European *Noctuae*. The moth is found in autumn, and is a great rarity in England, though found in all parts of the country occasionally; on the Continent, it is commoner, though never very abundant. The large grey caterpillar lives on poplar, aspen and ash from May to July, and forms its pupa in a cocoon between the leaves, or in a cleft of the bark.

Fig. r. *Catocala nupta*, the Red Underwing, is much commoner than the last species, and is found resting on walls or on the trunks of trees in July and August, though when the bright-coloured hind wings are covered by the fore wings, it is not always easy to see the insect. The larva is brownish grey with yellowish spots and interrupted streaks, and feeds on willows and poplars in May and June.

The *Geometrae* have a slender body, broad wings, similarly coloured, and generally expanded when at rest, and simple (rarely pectinated) antennae. The larvæ have usually only 10 legs, and they creep by bending their bodies. The pupa is most frequently naked. This group is less numerous than the *Noctuae*, but contains a much larger proportion of brightly coloured species.

Urapteryx sambucaria, the

Swallow-tail Moth, is the largest species of the group. The wings are pale sulphur-yellow, with olive-brown transverse stripes. It is not scarce in June and July. The caterpillar is brown with paler streaks, and is found in autumn on elder, lime, ivy &c.

Epione apiciaria is yellow with a brown border, and is not scarce in summer and autumn. The larva is greyish brown with fine longitudinal lines, and is found on willows and poplars.

Venilia maculata, the Speckled Yellow, is golden yellow, with irregular black spots. It is common in woods in May and June. The larva is green, with a dark line on the back, and feeds on dead-nettle and other low plants in autumn.

Selenia illustraria is flesh-coloured, varied with purplish-brown. It is found in May and July, but is not very abundant. The larva is of a colour resembling bark; it is grey, with paler and darker prominences. It is found in June and September on sloe, oak, birch, rose &c.

Fig. u. *Pericallia syringaria*, the Lilac Beauty, has olive-grey wings, varied with violet-grey. The fore wings are tinged with rusty-yellow, and there is a large whitish mark on the costa. It is found in gardens in July, but is not generally very com-

mon. The larva lives on elder, alder, bird-cherry &c.

Ennomos alniaria is ochreous-yellow, dusted with brown. The fore wings are marked with two brown lines, and there is a dark brown spot in the middle of the fore wings. It appears in August and September, but is a very scarce insect in England. The brown humpy larva feeds on alder, birch and lime.

Amphidasis betularia, the Pepper and Salt Moth, is a stout-bodied hairy moth nearly two inches in expanse, which looks more like one of the *Bombyces* than one of the *Geometrae*. It has chalky-white wings speckled with black, and is common in May. The



caterpillar is greyish brown with a pointed head, and feeds on various trees in autumn. When at rest, it resembles a dry twig, like the caterpillars of many other *Geometrae*.

Phorodesma bajularia, the Blotched Emerald Moth, is green with a white mark at the hinder angle of the fore wings, and whitish crescent-shaped markings on the hind wings. The brown caterpillar lives under a covering of fragments of plants. It is found on oak in May and the moth appears in July, but is not a very common insect.

Asthena luteata is a small yellow moth with brown bands, which is not very scarce in May and June. The pale yellowish-brown larva feeds on low plants.

Fig. w. *Abraxas grossulariata*, the Magpie Moth, is very common in gardens. The female lays her eggs in summer between leaf-stalks of the gooseberry and currant. The caterpillars are white, spotted with black, and appear in September, and pass the winter on the ground. Next year they attack the trees, and when they are full-grown, they suspend themselves to the branches by the tail, and surround themselves with a web.

Abraxas ulmata resembles the last species, being white, with a row of round violet-grey spots, and with large rusty-brown blotches marked with bluish white towards the margins. The moth appears in June, and is much less abundant than *A. grossulariata*. The bluish white caterpillar is found in August and September, feeding on elm and vine.

Fig. v. *Hibernia defoliaria* is one of the winter-moths, in most of which the female is wingless. In October and November the male is often seen flying in gardens, and the female climbs up the trunks of trees, where she lays her eggs. In April and May the caterpillars may be found on various



orchard and forest trees. They feed chiefly at night, and change to a brown pupa in the ground in July. The caterpillars are brown with a yellow line on the sides.

Fig. x. *Cheimatobia brumata* is the commonest of the winter moths, and is very destructive to fruit-trees. The moths appear from October to December, and the males fly about on fine autumn days, while the females creep up the trees, and lay about 250 eggs on the buds. As the leaves develop, the eggs hatch, and the caterpillars spin leaves and flowers together, until their webs sometimes cover whole trees. The caterpillars continue to grow till the middle of June, when they let themselves down from the trees by slender threads, and form their pupæ in the ground. The habits of the moths make it easy to protect the trees by placing belts of tar or lime round the trunks, which the females cannot pass.

The **Pyrales** have long fore wings and broad hind wings, a spiral proboscis, simple antennæ, long hind legs, and larvæ with seven pairs of legs, and small warts and hairs. They form their pupæ in the ground, or in a cocoon between leaves.

Cataclysta lemnata has white wings with brown markings, and is very common about ponds. Its brown larva feeds on duck-weed, or, according to some authors, on reeds.

Crambus margaritellus is one of the Grass Moths, many species of which are common in meadows. It is ochreous-brown, with a broad silvery-white streak on the fore wings.

The **Tortrices** are generally small moths, with the fore wings not much narrower than the hind wings, and cut off square at the ends. The antennæ are simple. Their caterpillars often roll themselves up in leaves.

Fig. t. *Hylophila bicolorana*, the Scarce Green Silver-lines, belongs to a small group of moths of uncertain position, which some authors place with the *Tortrices*. It is not quite so rare an insect as might be supposed from its name, which it derives from there being a commoner moth allied to it with 3 oblique instead of 2 straight lines on the fore wings. Its yellowish-green larva feeds on oak.

Tortrix viridana, the Green Oak-Tortrix, has



green fore wings bordered with yellowish in front, and brown hind wings bordered with white. The

caterpillar is green, spotted with black, and feeds on oaks. It is a very abundant insect.

Tortrix heparana, which has brown fore wings and grey hind wings is common in summer. Its greyish-green caterpillar lives in the rolled up leaves of trees.



The **Tineæ** have long slender antennæ, long narrow wings with long fringes, and naked larvæ, often with imperfect legs. Some make themselves cases, and others mine in the stalks and leaves of plants. They form the most numerous group of the *Lepidoptera*, and notwithstanding their small size, many are injurious.

Fig. y. *Tinea sarcitella* is ashy grey, with a white dot on each side of the back. The larvæ are very destructive to woollen fabrics.

Fig. z. *Tinea pellionella* is another equally destructive clothes-moth, which attacks furs. The moth has grey fore wings with a gilded lustre, and white hind wings.

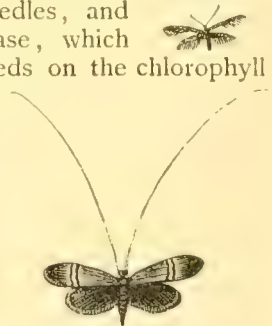
Fig. aa. *Tinea granella* has pale grey fore wings with dark brown and silvery white markings; the hind wings are grey. The caterpillar feeds on corn, and is often very destructive.

Euplocamus anthracinalis, one of the largest of the European *Tineæ*, is not found in England. It is black, with white spots on the fore wings, and is found in woods. The caterpillar lives in the fungi which infest trees.



Coleophora laricella is a little grey moth which sometimes flies in swarms in larch woods. The caterpillar lives in the larch-needles, and constructs itself a yellowish case, which it always carries with it. It feeds on the chlorophyll of the needles.

Adela Degeerella, the Long-horn Moth, is of a golden colour, with a white band on the fore wings; it is found in woods. The caterpillar lives on the ground in a case formed of two fragments of leaf, and feeds on low plants.



In the **Pterophoridaæ**, the fore wings are cleft into two feathers, and the hind wings into three. The legs and antennæ are long and slender. The larvæ are stout and hairy, and the pupa is naked. The commonest species is *Pterophorus pentadactylus*, the White Plume Moth, which is very common in gardens and weedy places; it is a little over an inch in expanse. The pale green caterpillar has 16 legs, and feeds on convolvulus.

In the **Alucitæ**, the wings are each cleft into six feathers. The only British species, *Alucita hexadactyla*, the Twenty-plume Moth, is a small yellowish-grey moth, which is common in gardens and woods, where its naked larva feeds in the buds of the honeysuckle, and changes to a pupa in a cocoon.



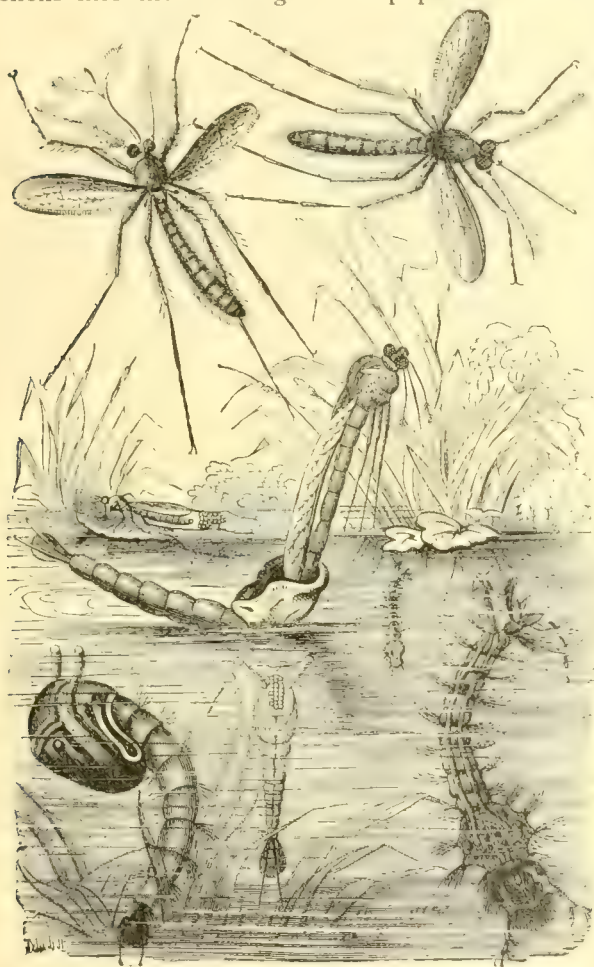
Twenty-plume Moth (magnified).

Order IV. **Diptera.** (Flies.)

Plate XXIII (left side).

The Two-winged Flies are of moderate or small size, and their metamorphoses are complete. Their bodies are sometimes long and slender, and sometimes short and broad. The head is divided from the thorax by a short stalk, and the thorax is frequently separated from the abdomen in the same manner. The antennæ may be long and slender, and bare or plumose; but they are more frequently short and only three-jointed, the last joint forming a scale to which a simple or tufted bristle is attached. They have large palpi, a proboscis adapted for sucking; large eyes, and sometimes, but not always, ocelli. The legs are moderately long, or, especially the hind legs, very long. Only the fore wings are developed, the hind wings, which are called poisers, being rudimentary.

The eggs are laid on decaying substances, or in water, or upon other animals, and soon become soft footless and often even headless maggots, which afterwards change into motionless pupæ, when the larva-skin is not thrown off, but contracts and thickens into the covering of the pupa.



Metamorphoses of Gnat (*Culex pipiens*).

The *Diptera* are extremely numerous, and are often of very small size. Some produce galls, and the larvæ of many species live in water.

Section I. **Nematocera.**

The antennæ are long, and have at least six joints.

Family I. **Culicidæ.** Slender flies with 4 jointed palpi, bushy or bristly antennæ, and a long probos-

cis. They come into houses, and sing at night, when their blood-sucking propensities make them very troublesome. Their larvæ live in water.

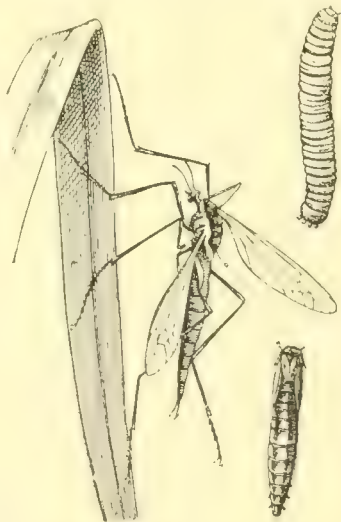
In the genus *Culex*, the proboscis is long, and armed with sharp bristles in the female. The antennæ are generally plumose, and the body and legs are long.

Fig. a. *Culex pipiens*, the Common Gnat, is pale brown with darker markings, and is about half an inch long. It is a great pest in damp neighbourhoods, or in hot wet summers, but is not very abundant in dry places, or in dry summers. The mosquitoes which are so troublesome in hot countries belong to the same genus. Volatile oils are useful to prevent their attacks, as long as the scent remains; and if the bites are bathed immediately with sal ammoniac, the irritation is soothed, and swelling prevented.

Family II. **Tipulidæ.** The Crane Flies are slender insects with a retractile proboscis and drooping palpi. The antennæ are bristly or filiform, many-jointed, and sometimes bushy. The legs are very long. The larvæ live in damp earth.

Fig. b. *Pachyrrhina pratensis* has a shining black thorax, and the abdomen is black, with yellow spots on the sides. The larvæ live in the soil of meadows, and do much mischief by destroying the roots of grass, and the flies are also found in meadows at the end of summer.

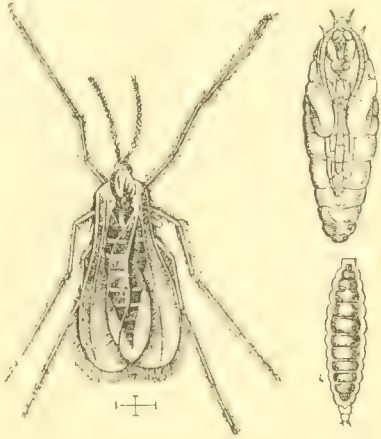
The species of *Tipula* have long and slender legs, bodies and antennæ, and prominent palpi. *Tipula oleracea*, which is one of the commonest, has a grey thorax lined with brown, a reddish brown abdomen, and pale brownish wings with the front edge reddish. The larvæ live in the ground from autumn to spring, change to pupæ in June, and emerge as flies in a few weeks, when the pupæ push themselves half out of the ground. There are some larger species with brown blotches on the wings.



Family III. **Cecidomyidæ.** The Gall-gnats have a long slender body, and short, but comparatively broad wings, with but few nervures. The flies are usually small and very delicate, and the larvæ of some species produce excrescences called galls on plants, and others injure them in different ways.

Cecidomyia destructor, the Hessian Fly, was thus named in America, because it was supposed to have been introduced into America during the War of Independence by the Hessian troops. Be this as it may, it has been known as a very destructive insect during certain seasons both in America and in many parts of Europe, for many years; and its appearance in England has lately been ascertained, though many think that it has always been with us, but has not caused sufficient damage in this country to attract attention before.

About the middle of April we may notice a little black gnat, with the end of the tail red, laying its eggs on the stalks of wheat and rye. In a short time the larvæ hatch, and ensconce themselves under the leaf-sheaths, where they remain until they become pupæ, and in August the flies appear. The stalks are so much weakened that they cannot remain upright, and bend over. The winter brood lives chiefly in stubble-fields in the scattered fallen stalks, where they pass the winter without assuming the pupa state till the following spring.



Family IV. **Mycetophilidæ**. These are small flies which are often excessively numerous. Their larvæ feed on fungi.

Sciara militaris, the Army-worm, derives its name from the curious habit of its larvæ, which assemble previous to their metamorphosis, and creep slowly forward in a douse column, three or four yards long, leaving a slimy trail behind them.

Family V. **Simuliidæ**. The Sandflies are small humpbacked flies with broad wings tinged with brownish, spotted legs, and the males and females generally differing in colour.

Simulia columbaccensis, which at times causes so much terror to man and animals on the lower Danube, is hardly larger than a flea. In the spring, they creep into the ears, nose and mouth of cattle in vast swarms, and torture them to death. In the case of men, they usually attack the corners of the eye, leaving a small hard swelling.

Family VI. **Bibionidæ**. Hairy flies, with bead-like, 9-jointed antennæ, and brown or white black-bordered wings.

Bibio marci, St. Mark's Fly, is a small black hairy fly with a large head, and broad smoky wings, obtuse at the end, and bordered with black. They fly heavily, and when at rest, let their wings and bodies droop. The female lays her eggs by hundreds in leaf-mould or cowdung. The maggots pass the winter in company in loose mould, and in February change into humped pupæ about two-thirds of an inch long. The flies appear in about a fortnight.



Section II. Brachycera.

The antennæ are short, and only three-jointed.

Family VII. **Tabanidæ**. The Gad-Flies have a broad head, with large greenish eyes, and a short strong proboscis. The body is smooth, and the wings are sloping when at rest. They fly well, and inflict a severe puncture with their proboscis, and even the smaller species often draw blood. The larvæ live in the ground, and the pupæ are hairy.

Fig. c. *Tabanus bovinus*, the largest European species, is dark brown with a row of white triangular spots on the back. It is found in woods and pastures, and is very annoying to cattle. The larva resembles those of the Crane-flies in form and habits, and lives in meadows.

Fig. d. *Hæmatopa pluvialis* is a smaller fly, with a slender dark brown body with grey markings. The wings are dark grey, marbled with paler. These flies are most troublesome during a shower or before a thunderstorm, and often settle in numbers under an open umbrella.

Family VIII. **Asilidæ**. Slender flies, with a long body, short antennæ, a prominent proboscis, and a tuft on the forehead. The wings are generally more or less extended when at rest. They are very voracious flies, and devour other insects.

Asilus crabroniformis, the Hornet Fly, has rusty yellow wings marked with a few dark spots. The head, thorax, and the greater part of the legs are yellow, and the abdomen is black at the base, and yellow towards the extremity.

The abdomen of the female ends in a horny point. These flies feed on other insects, especially crane-flies, which they pierce with their proboscis, and then suck out their juices.



Dioctrina oelandica.



Asilus crabroniformis.

Dioctrina oelandica, though it derives its name from the island of Oeland on the coast of Sweden, is found in the greater part of Europe. It has black wings, a shining black body, and reddish-yellow legs. It feeds on flies as well as on spiders.

Family IX. **Empidæ**. The 3-jointed antennæ, which are prominent, are near together at the base, and the tip is furnished with a pencil or bristle. The proboscis is prominent, and the palpi are erect. They dance in great swarms in the evening, and they feed on the honey of flowers, and on the juices of small insects which they seize and suck out like the *Asilidæ*.



Empis tessellata.

Empis tessellata is brownish grey, with three black stripes on the thorax, and pale brown wings. The abdomen has shining yellowish-brown spots.

Family X. **Bombyliidæ**. The antennæ are prominent, 3-jointed, and near together. The proboscis is projecting, and often very long, and the wings are broad, always expanded, and generally coloured. The body is clothed with fine hair. The flies suck honey, but their larvæ are parasitic on other insects.

Anthrax morio is black, with the base and sides of the abdomen clothed with red hair. The wings are black at the base, and transparent beyond. The fly is seen in summer on dry paths. It likes to rest in sunny places, and flies away swiftly when approached, but to no great distance. The larva is parasitic on caterpillars.



Fig. e. *Bombylius major* has a smaller head than the last species, and a compact shape like that of a small humble-bee. The body is clothed with silky yellowish hair above, and with white hair below. The front of the wings is dark brown to the tip, and the rest is transparent. It flies with a rapid hovering flight from flower to flower, diving its long proboscis into them without resting. Its movements much resemble those of the Hawk-moths.

Family XI. **Stratiomydæ**. The prominent 3-jointed antennæ are near together at the base, the body is broad, and the proboscis long and retractile. The scutellum is usually spiny. The larvæ live in the earth or water; in rotten wood &c.

Stratiomys chamæleon is brown, with a black abdomen with yellow markings, and yellow legs. When at rest, the wings lie flat on the body. The larva lives in the water, and breathes through its tail, which it lifts above the surface. The flies fly noiselessly from flower to flower, but buzz loudly if held in the hand.



Family XII. **Syrphidæ**. The proboscis is bristly, but concealed, and the antennæ are 3-jointed, with the third joint compressed, and furnished with a pencil at the end, or a bristle on the back. The larvæ feed on plant-lice (Aphides).

Syrphus pyrastris is shining blue-black, with two white crescents on each segment. The legs are reddish yellow. In summer weather these flies dart about from place to place like an arrow, in the way characteristic of the hovering flies. They often stop suddenly in their flight, and remain hovering at one spot in the air, and then suddenly dart forward, and stop again as before. The green larva feeds on aphides.

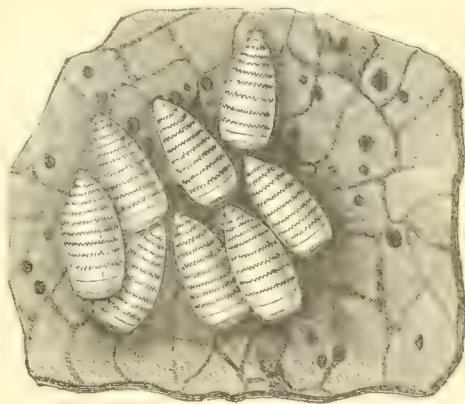


Fig. f. *Volucella bombylans* may be known by its very downy body. It is black, with the thorax clothed with yellow hair, and black in the middle. The abdomen has yellow spots on the sides at the base, and yellow hair, but the tip is white. The larvæ feed on the larvæ and pupæ of humble-bees.

Family XIII. **Æstridæ**. The bodies of the Bot-flies are covered with thick hair, and the proboscis is usually absent. The perfect insect only lives a short time, to propagate its species. The larvæ live under the skin, or in the frontal sinuses or in the intestinal canal of various animals, but the pupæ are free.

Ampullia &c.

Gastrophilus equi has the form of a bee. It has brown eyes, and a brown downy forehead; the body is clothed with golden-brown down. There is a grey band across the wings, and two spots at the tip. The female lays her eggs on the hairs of the horse, and the newly hatched larvæ either creep to the lips them-



Larvæ of Bot-fly in stomach of horse.

selves or are licked off the skin, and thus introduced into the stomach of the horse. When the larva has completed its development, it passes out with the dung, and becomes a pupa in the ground.

Fig. g. *Hypoderma Bovis* is black, with a furrowed thorax, red before and black behind. The abdomen is green at the base, and yellow behind. The female is larger and brighter coloured than the male, and lays her eggs singly at different points on the hide of horned cattle, especially on the back. The maggots cause a swelling on the skin by their presence. When full-grown, they squeeze themselves out of the sore, which resembles a boil, and fall to the ground, where they change to pupæ.

Æstrus ovis, the Sheep-Fly, is quite hairless, and has a brown head, a green back, and a grey abdomen marbled with black. The female lays her



eggs in the nostrils of sheep, from whence the larvæ creep up to the nasal sinuses, and feed on the mucus. When they are full-grown, they are sneezed out, and become pupæ in the ground.

Family XV. **Muscidæ**. The body is bristly, and the last joint of the antennæ is rather long, obtuse, and furnished with a pectinated bristle. This large family is divided into a number of minor groups.

The *Tachinina* have the abdomen set with numerous stiff raised bristles; and are parasitic on other insects. The second joint of the antennæ is the longest.

Echinomyia ferox is black, with a yellow face, and a yellow abdomen divided by a black longitudinal streak. The larvæ infest other larvæ, chiefly those of *Lepidoptera*, several at a time.



The *Sarcophaginae* do not come much into the house, but are more often seen in the open air, where decaying animal and vegetable matters are to be found. Their form is compact, and they fly well.

Fig. h. *Sarcophaga carnaria* is grey with red eyes, and with square black spots on the abdomen. It is ovoviviparous, for it deposits living larvæ on meat instead of eggs; i. e. the eggs are hatched within the body of the mother.

The true *Muscinae* resemble the last subfamily, but are more domestic in their habits.

Fig. i. *Calliphora vomitoria*, the Blue-bottle, has a black thorax, and a shining steel-blue abdomen, with black bands. It makes its presence known by its loud buzzing, and appears at once wherever there is any carrion. Here the female deposits her eggs, and the larvæ feed greedily on even the most putrid carrion.

Fig. k. *Musca domestica*, the House Fly, is the most familiar of all the flies, and accompanies man all over the world. The whitish larva is found in dung and other refuse. Fig. k. represents the head of the fly, highly magnified.

Fig. l. *Stomoxys calcitrans* is a grey fly, with the abdomen spotted with black. It resembles the common fly, but is smaller, and when at rest, its wings remain expanded. It inflicts a severe puncture, and sucks blood.

The *Anthomyiinae*, or Flower Flies, are not unlike the *Muscinae*, but their colours are more varied, and their antennæ are not hairy.

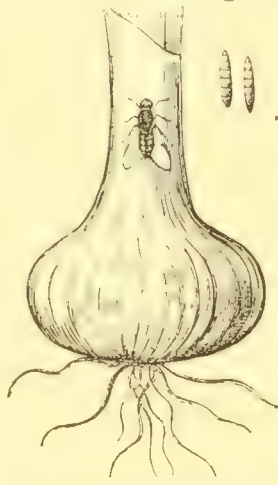
Anthomyia brassicae is greyish black and hairy; the head is white, and the two first segments of the abdomen are brownish red. The larvæ live in the roots of cabbages &c.



Anthomyia floralis. The larva of this species lives in the roots of radishes in July, making long galleries through them. They quit them when they are ready to become pupæ, and burrow in the ground



Anthomyia floralis.



Anthomyia ceparum.

Anthomyia ceparum, the Onion Fly, lays its eggs on various kinds of onions, on which the larvæ feed.

The *Trypetinae* have the wings dark, or marked with delicate patterns. The female has a long jointed ovipositor. The larvæ feed in seeds or on living plants.

Platyparca paciloptera has a shining reddish-brown head, a grey thorax, and a black abdomen, ringed with grey. The legs are brown. The female lays her eggs between



the scales of an asparagus head, where the larvæ develope, and often devour the whole stalk.

Trypeta signata is a little reddish fly with green eyes, and wings spotted and banded with brown. The female lays her eggs on unripe cherries in May and June. As the fruit ripens, the maggots also become full-grown, when they fall to the ground, where they become pupæ, and give birth to flies in spring.



The *Chloropinae* are small flies, which are noteworthy for the numbers in which they appear, and the damage which they occasion to corn.

Oscinis frit is a little black fly with transparent wings. It resembles the Hessian Fly in habits, and has been reared with it from the leaf-sheaths of barley. It also bores deep into the knots at the root. There is generally more than one brood in the year, which renders it still more destructive.



Chlorops tenuipus.

Family XVI. **Phoridae**. These are small hump-backed flies which run actively about bushes, on windows &c.

Fig. m. *Phora incrassata* is shining black, with the abdomen dull grey. The wings are transparent, and traversed by four longitudinal nervures. It is a dangerous parasite of the honey-bee, and occasions what is called foul brood. The female lays her eggs under the skin of the half-grown larva of the bee, in which the larvæ live till the last moult, when they quit the bee-larva, and it dies

Section III. Pupipara

These are parasitic flies, sometimes wingless, and generally with long sprawling legs.

Family XVII. **Hippoboscidae**. The thorax is leathery, and the proboscis is absent. The legs are thick, and the feet are armed with strong claws. They live parasitically, chiefly on warm-blooded animals, and bring forth their young in the pupa state.

Hippobosca equina, the Forest Fly, is shining rusty-yellow, with the middle of the thorax chestnut-brown, and the legs black. The wings are brown, and longer than the body. They infest the bare parts of horses, especially on the belly, and under the tail. If anyone tries to seize them, they take a short flight, and settle on the horse again; and if they are seized, they easily slip their tough bodies between the fingers. A similar insect with long narrow wings is found in swallow's nests.



Melophagus ovinus, the Sheep-tick, belongs to this family. It is wingless, and runs among the wool of sheep.

Family XVIII. **Nycteribiidae**. These insects are wingless, and resemble spiders in their outward appearance. They have horny, flattened bodies, and a very moveable pitcher-shaped head. They are yellow, and of very small size. They are parasitic on different kinds of bats.

Family XIX. **Braulidae** somewhat resembles the *Nycteribiidae*. *Braula caca*, the Bee Louse, is blind and wingless, and is parasitic on bees.

Section IV. Aphaniptera.

Family XX. **Pulicidæ**. In the Fleas, the body is wingless and laterally compressed, the head is small and bent forwards, and the antennæ are short, with from 2 to 4 joints. The thorax and abdomen are not distinctly separated. The legs are long, and the hind legs are thick, and formed for leaping. They live parasitically on men and animals, and suck their blood, and the larvæ live among decaying substances, between the cracks of boards &c.

Fig. n. *Pulex irritans*. The common Flea is an oval reddish brown insect. The small whitish larvæ change to pupæ in a silken cocoon.

Fig. o. *Sarcopsylla penetrans*, the Chigoe, is very small, and the proboscis is as long as the body. It lives in sandy places in South America, and burrows in the flesh, often between the toes or under the nails, causing dangerous ulcers if neglected, both in man and beast.

Order V. Neuroptera.

Plate XXIV (right side).

The *Neuroptera* have a rather long body, four membranous wings, which are usually of similar texture, and traversed by net-like, or else by longitudinal nervures. The jaws are usually formed for biting, and the insects are carnivorous in all their stages. The larvæ live in the water, in dry ground, or on trees.

The metamorphosis is complete or incomplete; in the former case, the larva and pupa are dissimilar to the perfect insect, and the pupa is quiescent; in the latter, the larva resembles the perfect insect, except that it is wingless when it quits the egg. As it grows it moults several times, and at the last moult before assuming the perfect state it acquires the rudiments of wings. It is then called a pupa, though it still continues to move and eat; and when it casts off this skin, the perfect insect appears.

In the first families of *Neuroptera*, the metamorphosis is complete; and in the others incomplete. Those with incomplete metamorphoses are frequently included by modern writers with the *Orthoptera*, though the propriety of this arrangement may be doubted.

Family I. **Phryganidæ**. (Caddis-flies.) These insects often resemble moths. They

have long simple antennæ, two ocelli, the wings are frequently hairy instead of scaly, and the hind wings are folded, and shorter than the fore wings. The larvæ construct cases for themselves of different materials, in which they creep about at the bottom of the water. Some are composed of fine grains of sand, others of very small shells, and others again of bits of wood or straw, which are arranged either crosswise or lengthwise. In these cases the larvæ live and change to pupæ, when they close the entrance with a lattice-work formed of thin layers of brown silk.

Fig. 1. *Phryganea grandis*, the largest species, is by no means uncommon. It has ashy-grey fore wings with brown markings, and the hind wings are transparent, with yellowish brown nervures. The larvæ live in standing or running water, and make themselves cases of the stalks of leaves.

Family II. **Sialidæ**. The wings are coloured, and the hind wings are broader at the base than the fore wings, but are not folded. The antennæ are simple, and longer than the head.

Sialis lutarius has a dark brown body, and light brown wings with dark nervures. The perfect insect is carnivorous, and flies about heavily near water. The larva lives in water, but when about to become a pupa, it creeps out on the bank.

Family III. **Raphiidæ**. (Snake-Flies.) The prothorax is long and narrow, as is also the neck, which bears the small head. The carnivorous larvæ frequent the bark of trees.

Fig. p. *Raphidia ophiopsis* is dark brown, with yellow stripes on the abdomen. It is usually found among trees and bushes, where the larva destroys numbers of injurious insects.

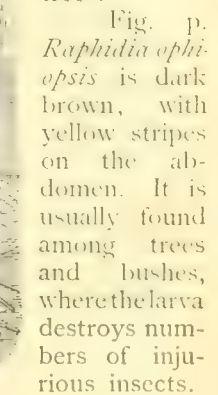
Family IV. **Panorpidæ**.

(Scorpion-Flies.) The head is provided with a long beak, and the abdomen of the male terminates in a forceps. The wings have only a few veins, and are either of equal length, or the hind wings are the longest.

Fig. o. *Panorpa communis* has a dark body, and dark brown bands and spots on the wings. The beak, and the forceps of the male are red. The flies are found about bushes and hedges, where they and their larvæ prey on other insects.



Phryganea grandis and larva



Family V. **Hemerobiidæ**. The body and wings are slender, the antennæ long and simple, and the eyes round. The jaws are small. The perfect insects have a weak flight, and a disagreeable smell. The larvæ are found on leaves, where they feed on Aphides.

Fig. m. *Chrysopa perla*, the Lace-winged Fly, has a greenish-yellow body and glassy iridescent wings with green nervures. It fixes its eggs to leaves singly, on long stalks. The active larva is so voracious that it has been called the Lion of the Aphides.

Family VI. **Myrmeleonidæ**. The Ant-lions are very like the dragonflies in shape, but the abdomen is shorter in proportion, and the antennæ are clubbed at the tip. The larvæ which live in sand, take two years to attain their full growth. There are no British species of this or of the following family.

Fig. n. *Myrmeleon formicarius* has a dark grey body, with pale spots on the head and thorax. The segments of the abdomen are also bordered with paler behind. The wings are transparent, reticulated and spotted with brown. The perfect insect rests with sloping wings during the day, and does not fly about till sunset. The larva, the real Ant-lion, is short and thick, about three-quarters of an inch long, and digs itself a circular pitfall in the sand, from which only its jaws project in the middle. Here it lies in ambush, till an ant or some other insect falls into the pit, when it seizes it, and sucks out its juices. If the insect does not fall to the bottom, and tries to escape, the ant-lion throws up showers of sand with its shovel-shaped head, until the prey falls to the bottom of the pit. When it has sucked the insect dry, it jerks the empty skin out of the pit in the same way. The species figured is common in many parts of Central and Southern Europe during the summer.

Family VII. **Ascalaphidæ**. In these insects, the antennæ are long, and clubbed at the end. The abdomen is oval, and the wings are broad. The hind wings are frequently blotched with black and yellow, which increases their resemblance to a butterfly. The larvæ resemble those of the Ant-lions, but construct no pitfalls.

Family VIII. **Perlidæ**. The Stone-flies have



Perla bicaudata.

reticulated wings, the hind wings being as long as the fore wings, and the abdomen is broad, and ter-

minates in two short filaments. The antennæ are moderately long. The metamorphosis is complete.

Perla bicaudata has a brownish-yellow thorax bordered with darker, a reddish yellow head, and a brownish yellow abdomen. The wings are yellowish, but transparent, and the nervures are darker. They prefer the neighbourhood of running brooks. The female lays her eggs in the water, and the carnivorous larvæ hide under stones and in crevices.

Family IX. **Ephemeridæ**. The organs of the mouth are very imperfectly developed, the antennæ are moderately long, and the fore wings are much longer than the hind wings. The abdomen is long and rather slender, with 2 or 3 long terminal filaments. The larvæ and pupæ live for several months, or perhaps a year or two, in the water, and have horny jaws. The perfect insects are seen flying over water, often in immense swarms, but only live a few hours.

Fig. k. *Ephemera vulgata*, the common May-fly, is one of the larger species. It is brown, and the body is dark yellow, with three rows of orange spots. The wings are transparent, pale brown, and spotted. The larvæ are carnivorous, and live in crevices washed by the water. They only differ from the pupæ in wanting the rudiments of wings. When they have arrived at maturity, they quit the water, but it is very curious that after the perfect fly emerges, it moults again, even to the wing-coverings, which is not the case with any other insects. The Mayflies are most abundant at the end of May, and at the beginning of June.



Palingenia horaria is another species, which is not British, but is often seen in great abundance on the Continent in August. It is milkwhite, with the front of the head, the eyes and the front legs partly black, and the front edge of the fore wings grey. It often flies to lamps near the banks of rivers in countless thousands.



Family X. **Libellulidæ**. The Dragonflies have long slender bodies, and netlike wings, which are generally transparent. They have a large head and powerful jaws, but very short antennæ. The larvæ live in water and have a curiously constructed movable lower lip; and the perfect insect is also generally found near water, though the larger species, which have a very powerful flight, are frequently met with at a considerable distance from it. The Dragonflies feed voraciously on other insects in all their stages.

Fig. j. *Calopteryx virgo*, the Damsel-Fly, is very abundant flying over water. The male is blue, and the wings are transparent at the base and at the tip. The female has a metallic green body and brown wings. The larva lives in water, and changes to a pupa with the rudiments of wings, while still quite young and small, after which it continues to grow considerably.

Agrion puella is a much smaller insect, with transparent wings. The male is blue, spotted with bronze, and the female is bronze spotted with blue. It is very common about brooks throughout the summer.



Aeshna cyanea is one of the commonest of the larger dragonflies. It is brown, with yellow markings on the thorax, and blue or yellow spots on the abdomen. The wings are transparent.

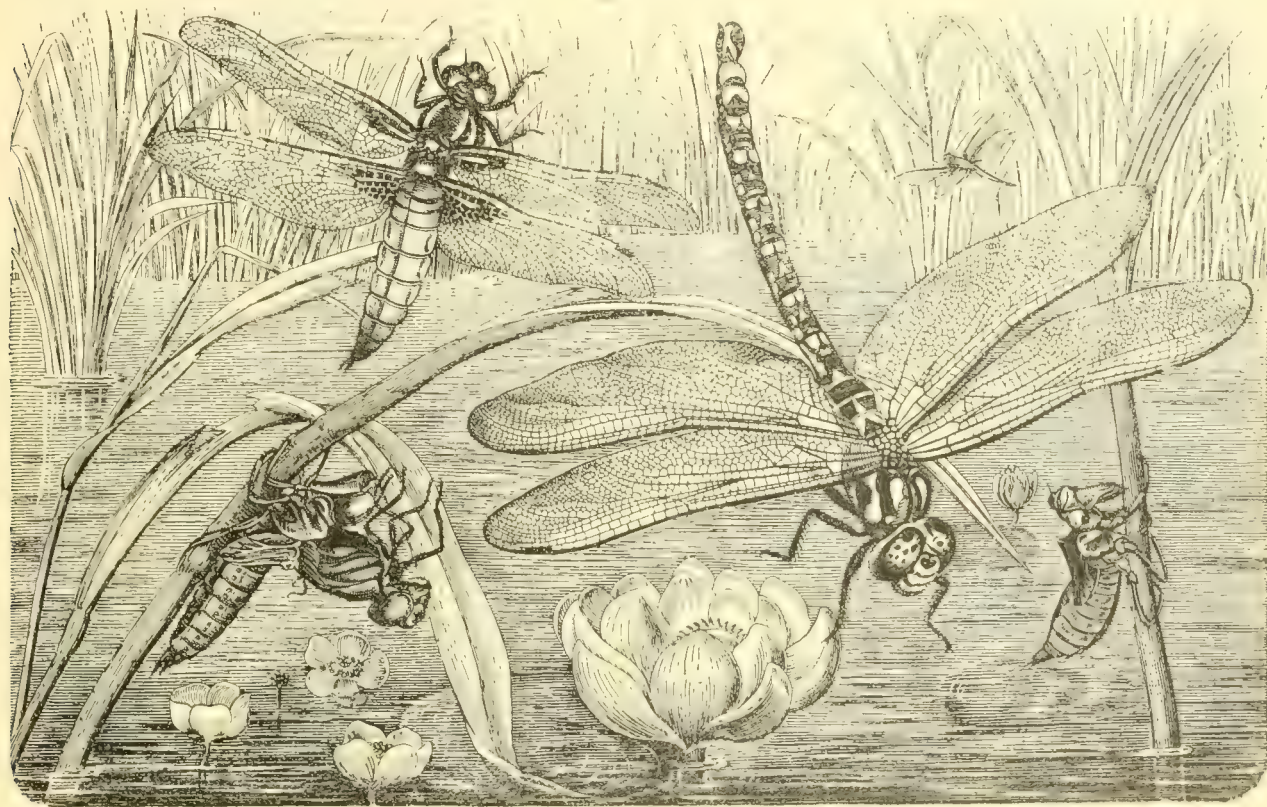
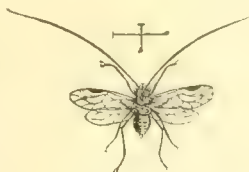
Libellula depressa is another large species, but of a different shape to the last. The thorax is brown, and the abdomen, which is short, broad and flat, is blue in the male and yellow in the female. The wings are transparent, with the base brown.

Family XI. **Psocidæ**. These little insects are exclusively found on land. The wings are very long, with only a few veins, and slope over the oval body.

Psocus lineatus has long black antennæ, and a yellow body, with black rings on the abdomen. It is found on tree-trunks and planks.

Family XII. **Termitidæ**. The Termites, like the ants, live in large communities in nests. They

She is wingless, and is said to lay 80,000 eggs in a day. Besides the ordinary working larvæ, there is a small number of another form, with larger heads and stronger jaws. They are called soldiers, for they do not work, but defend the nest. The termites' nest contains many rooms for eggs and provisions, besides galleries, bridges &c. When the Termites find their way to anything which they can eat, they destroy it in an amazingly short time, and will destroy whole chestsful of clothes, books &c. in a few hours. In the year 1814 they undermined the palace of the governor of Calcutta to such an extent that it fell in; for they destroy all woodwork from the inside. These animals, destructive as they are, are useful in hot countries, where all refuse begins to putrefy immediately; for this they destroy. Their numbers must be reckoned by millions. As soon as all the larvæ and pupæ have been transformed into winged insects, they fly up into the air in a swarm, and drop down in other places. At these times great numbers of animals and birds feed upon them, and they are frequently used even for human food.



Libellula depressa and pupa.

Aeshna cyanea and pupa.

may be divided into the following classes: 1) winged males and females, with a round head and moderately long abdomen; 2) the fertilised female, with an enormously swollen abdomen, which lays eggs by the hundred thousand; 3) wingless larvæ, which perform the work of the nest; 4) wingless and eyeless soldiers, with strong pointed jaws. The males and females soon cast their wings.

The Termites inhabit warm countries, where they build large conical and pyramidal nests composed of clay and fragments of wood, which are often 15 or 20 yards in circumference, and 3 or 4 yards high. They are so strong, that a man can stand upon them without their yielding; and the most violent storms do not injure them. In the interior of the nest are two large chambers, containing a female and several males. When the female is ready to lay eggs, she attains an immense size.

Figs. q, r. We have figured the sexes of *Termes angustatus*, a native of South Africa; and also *Termes bellicosus* (which inhabits West Africa) with its nest.

The following families are aberrant, and are sometimes treated as separate Orders. Except the first, they are all wingless insects, which undergo no proper metamorphoses.

Family XIII. **Thripidæ**. These insects are sometimes placed with the *Orthoptera*, or in an Order by themselves called *Thysanoptera*. The body is small and narrow, the wings are narrow, and have long fringes, the legs are short, and the feet are very imperfectly developed. They live on leaves and flowers, feeding on the upper cuticle, and leap by bending the abdomen.

The species figured, *Thrips vulgatissima*, is dark brown with white wings. It lives in the calyces of garden-flowers. (See next page.)

Thrips cerealium is very destructive to corn. These little black insects may be seen resting on the ears of wheat, barley, and rye, in May and June, sometimes 30 or 40 together. They suck the ears and stalks, and cause them to wither. The insects, which are at first apterous, hibernate and lay their eggs in spring.

Family XIV. **Phyllophloidae**. This is one of the families of **Mallophaga**, or Bird Lice, which differ from the other lice in being man-

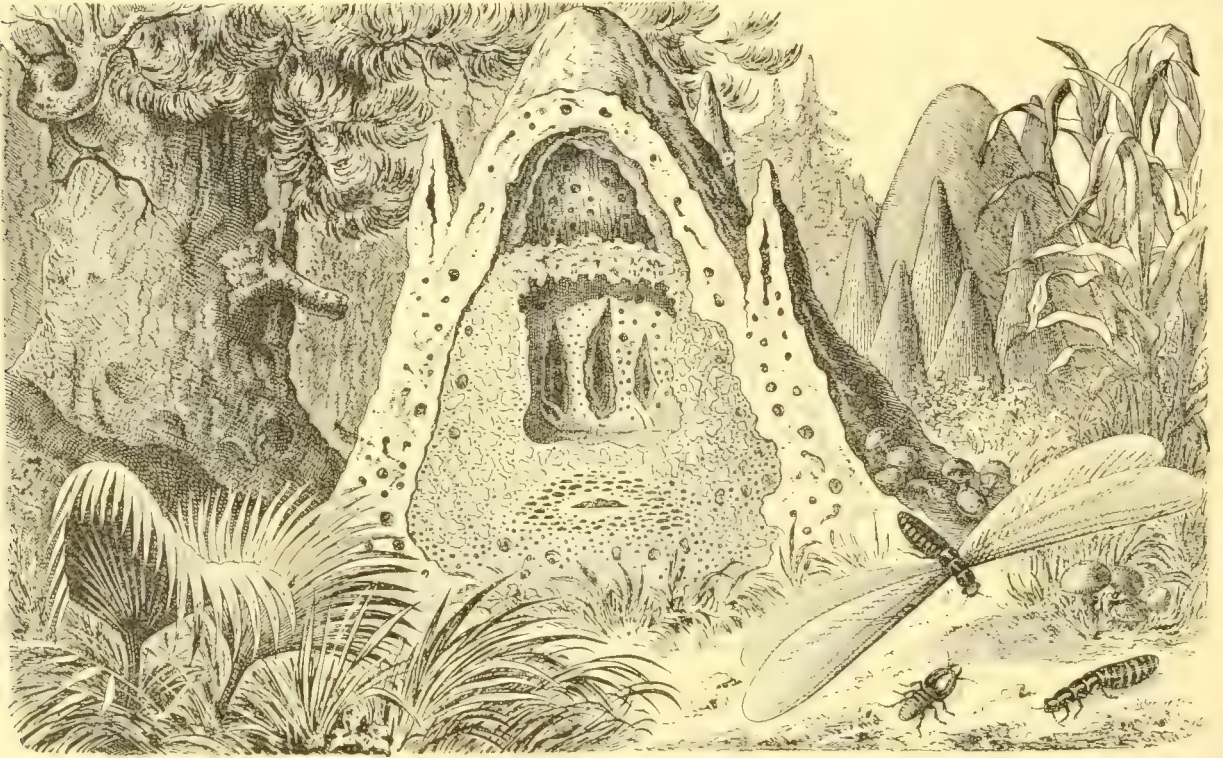


scales, which is found in store houses, larders and crevices.

Family XVI. **Poduridae**. The *Collembola* to which this family belongs, have a shorter abdomen than the *Thysanura*, and their legs, antennae and leaping apparatus are also generally shorter. They live in damp places under fallen leaves, in rotten wood, in water, or even on ice or snow. One of the most



Silver-Fish.

Nest of *Termes bellicosus*.

Winged male Workers.

dibulate insects. We have figured *Goniodes falcicornis*, a yellow species, spotted with brown on the sides, which infests the peacock.

Family XV. **Lepismatidae**. The Spring-tails are typical of the **Thysanura**. They have a soft body, clothed with a fine dust, and the abdomen is provided with an apparatus for leaping.

Lepisma saccharina, the Silver Fish, is a slender active insect, covered with silvery white



remarkable is *Isotoma saltans*, the Glacier Flea, a little black hairy insect, which abounds on the glaciers of the Alps.

Podura villosa is a reddish-brown species with black bands, which is found under fallen leaves.



Order VI. Orthoptera.

Plate XXIV (right side). *

The *Orthoptera* have imperfect metamorphoses, and the pupa is active. The fore wings (or tegmina) are much harder and narrower than the hind wings, and the hind legs are generally fitted for leaping. They are mandibulate insects, and are mostly vegetable feeders.

Family I. **Forficulidae**. In the Earwigs the body is long and provided with a forceps behind. The antennae are filiform, and the wings are large, and folded inwards under the short wing-cases. They are very destructive to flowers and fruit.

Fig. a. *Forficula auricularia* is brown, and the forceps of the male is dentated. The insect

hides in crevices during the day, and is only active at night.

Family II. **Blattidae**. The Cockroaches have a flattened body, a broad head, often concealed under the thorax, and long legs. The tegmina overlap, and the wings are longitudinally folded. They run about actively in all their stages. The eggs are laid by the female in a single mass, which she carries about with her half-laid for some hours.

Fig. b. *Blatta orientalis*, the Common Cockroach is a very troublesome insect, which is abundant in kitchens and bake-houses, especially near the hearth, for it loves warmth. In the night, the Cockroaches

emerge from their hiding-places, and devour any food which they may find lying about; they will even gnaw wet shoes and woollen fabrics, but if anybody comes with a light, they scurry away to their hiding-places. They are about an inch long, and the female is wingless.

Family III. **Mantidæ**. In the Praying Insects the head is vertical, the prothorax is long and slender, and the front pair of legs are dentated, and used as prehensile organs, the other pairs being fitted for walking.

Fig. c. *Mantis religiosa* is grass-green, and very variable in size; it feeds on other insects. It is common in South Europe and in Africa and waits for prey on bushes, with its fore legs extended.

Family IV.

Phasmidæ. The Stick Insects are very remarkable for the great length of their slender bodies. Their legs are all fitted for walking. They are chiefly natives of the tropics, and live among bushes and underwood. They so much resemble their surroundings that they can hardly be noticed by their enemies when resting during the day, for they feed on vegetable food at night.

One or two small species of *Phasmidæ* (about three inches long) are found in Europe on the shores of the Mediterranean, but the tropical species are far more remarkable. As a representative we have figured *Ceraocrana papuana*,

which is found in New Guinea. It has very short tegmina, but the wings are of enormous size. The legs are long, slender and strongly dentated.

Phyllium siccifolium is a green insect, common in the East Indies, which is remarkable for its resemblance to a leaf. The wings are not so long as the abdomen. Several species of these Walking Leaves are found in Asia and Africa.

Fam. V. **Gryllidæ**. In the Crickets, the head is large and vertical, without ocelli, the hind legs are long and

thick, and the tegmina are shorter than the wings. The male chirps by rubbing the tegmina together.

Fig. f. *Gryllus domesticus*, the House Cricket, is common in many houses, generally seeking shelter near the hearth, and only coming out at night. It is of a dull yellow colour.

Fig. g. *Gryllus campestris*, the Field Cricket, is much larger and darker coloured than the last species. It makes burrows in dry grassy places, and is very active. It is very scarce in England.

Fig. e. *Gryllotalpa vulgaris*, the Mole Cricket,

is rarely seen on the surface of the ground. It has large shovel-shaped front legs like a mole, which it uses to burrow in a similar manner; and it is a very destructive insect, for it destroys the roots of grass and plants by burrowing, even though its food may partly consist of other insects &c.

Family VI.

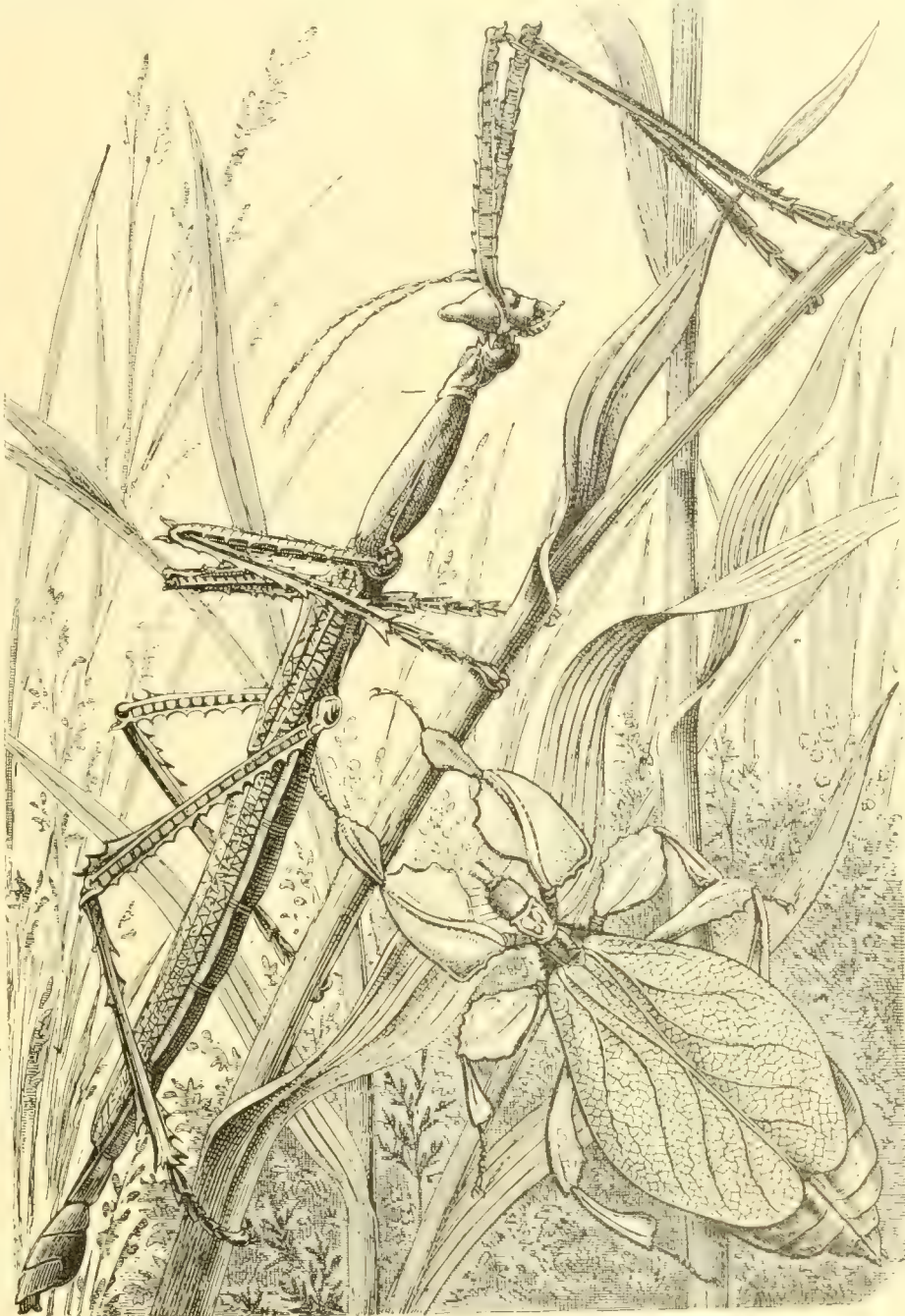
Phasgonuridæ.

In this family the head is vertical, and round or triangular, the antennæ are long and slender and the jaws are powerful. The wings and tegmina are equally long. The hind legs are long and thick, and fitted for leaping, and the female has a long ovipositor.

Fig. d. *Phasgonura viridissima*, the Great Green Grasshopper, is not uncommon in meadows and cornfields, but is very likely to

elude observation by its green colour, especially as it rarely uses its wings, but leaps from stalk to stalk. The males chirp. The female lays her eggs in the ground.

Family VII. **Locustidæ**. The Grasshoppers and true Locusts are distinguished from the last family by their short antennæ. The head is vertical, and the antennæ are cylindrical. The wings and tegmina are equally long, and the hind legs are adapted for leaping. The ovipositor of the female is shorter and broader than in the last family, and she digs a



Ceraocrana Papuana.

Phyllium siccifolium.

hole in the ground in which she deposits her eggs. The males chirp loudly.

Fig. h. *Locusta migratoria*, the Migratory Locust, has grey tegmina spotted with brown, and the wings are greenish. The hind femora are dark green, and the tibiae brownish-red. They are only occasional visitors in England. The eggs, to the number of 150, are laid in hard clusters near the surface of the ground, and hatch in the following

spring. The larvæ moult five times, and are full-grown about Midsummer. They are most destructive in all their stages, for they eat down grass and corn to the roots, and destroy everything which comes in their way.

Fig. i. *Ædipoda stridulum* is a conspicuous insect on the Continent by its red wings, but is not found in England. It flies with a grating sound in vineyards and dry slopes, and might be mistaken for a butterfly on the wing, from its bright colour.

Order VII. Hemiptera.

Plate XXV (left side).

The *Hemiptera* have generally four wings, which are not scaly. They have a long proboscis, with which they suck the juices of plants, and sometimes of animals. They are divided into three large sections.

Section I. Heteroptera.

In the true Bugs, the antennæ are of moderate length, and often angulated; the body is compressed, and often broad, the scutellum is large, and the front wings are horny at the base, and membranous at the tip; the hind wings are also membranous. A few species are apterous. Many of them exhale an unpleasant odour. Most species live on plants; those which are aquatic are a) thorax. b) corium. c) membrane. d) hind wing. e) scutellum.



Family I. **Pentatomidæ**. The body is generally short, broad and smooth, and the antennæ are placed on each side of the head, with the base of the proboscis between them. The scutellum is very large, sometimes almost entirely covering the wings when they are closed.

Fig. u. *Graphosoma lineatum* is striped with red and black above, and is red with black spots beneath. The antennæ and legs are black. It is common on umbelliferous plants in Central and Southern Europe, but is not British.

Fig. v. *Tropicoris rufipes* is one of the commonest species of the family on grass and bushes. It is dark brown, with reddish spots on the sides of the abdomen, and at the end of the scutellum, and has red legs. The shoulders are very prominent.

Fig. w. *Pentatoma baccarum* is reddish brown and is clothed with fine hair. It is fond of various kinds of berries, to which it imparts a disagreeable flavour.

Eurydema ornatum is found on Bitter-Cress, and has a yellowish thorax spotted with black. The scutellum is red with a black spot, and the wings are very variable in colour, sometimes red and sometimes black.

Family II. **Coreidæ**. These insects have a long body and a small head. The proboscis is provided with a long sheath, and the antennæ are longer than the head.

Fig. x. *Syromastes marginatus* is yellowish brown speckled with black. It is found on bushes in all parts of Europe, and hibernates in the perfect state.

Family III. **Pyrrhocoridæ**. The form is oval, and the head projects between the antennæ in an obtusely-pointed triangle. The wings are imperfectly developed, and sometimes absent.

Fig. y. *Pyrrhocoris apterus* is common at the foot of old lime trees and nut trees. The legs are black, and the body and wings are varied with red and black.

Family IV. **Lygæidæ**. These bugs, which much resemble those of the last family, are generally to be found under stones and moss.

Fig. z. *Lygæus equestris* is a red and black species which is sometimes found in great numbers in the rotten trunks of oak-trees. It is, however, very rare in England, if found at all.

Family V. **Cimicidæ**. The species are round or oval, and smooth, with a small head. The proboscis is enclosed in a short sheath, and the legs and antennæ are of moderate length. The wings are frequently undeveloped.

Fig. aa. *Cimex lectularius*, the Bed-Bug, is reddish brown with short black hairs. It hides in crevices by day, and comes out at night to suck blood. It emits a very disagreeable odour. It is now found all over the world, but is probably originally a native of Africa.

Family VI. **Reduviidæ**. The Wheel-Bugs have the head long and narrow at the base like a neck, a short proboscis, and long slender antennæ. The fore wings have only a few nervures, and the legs are usually long.

Fig. bb. *Reduvius personatus* feeds on other insects. It is greyish brown, with red legs. During the day it hides in crevices, or under bark or moss, and comes out at night in search of other insects, on which it preys. The larvæ are very hairy, and live among rubbish.

Family VII. **Hydrometridæ**. The body is long, as well as the legs and antennæ, but the wings are generally rudimentary or absent. The fore wings are of a leathery texture throughout.

Fig. cc. *Hydrometra paludum* is a dark brown species which runs and leaps with great agility on the surface of standing water, and feeds on other insects.

Family VIII. **Nepidæ**. The Water Scorpions have a small round head, and a strong curved proboscis. The legs are long and bare, and the front legs, which are used to seize prey, somewhat resemble the pincers of a scorpion.

Fig. dd. *Nepa cinerea* is a brown insect, with a red abdomen which is usually concealed by the wings. They creep slowly at the bottom of stagnant water, and fly about at night.

Family IX. **Notonectidæ**. The Water Boatmen have a very short broad head, and the hind legs are long and fringed, and serve as oars.

Fig. ee. *Notonecta glauca* is black, with the head and thorax whitish. The wings are yellowish-brown with brown spots. The belly is smooth and hairy, and the back is boat-shaped. It is an excellent swimmer, and rows itself about very rapidly on its back.

Section II. Homopterae.

In the *Homoptera*, the wings are of uniform consistency throughout, and the fore and hind wings are generally similar. The antennæ are usually short.

Family X. **Cicadidæ**. The *Cicadidæ* have a broad head with large eyes and a long proboscis. The fore wings are considerably longer than the hind wings. There are two cavities on the undersurface of the first segment of the abdomen, at the base of which a membrane is stretched, which is contracted by a strong muscle, by which the insects are able to produce a loud singing.

Cicada orni is common in Southern Europe on the manna-yielding ash. It is yellowish with the segments of the abdomen bordered



with red, and a row of black spots on the fore wings.

Fig. hh. *Tacua speciosa* is a magnificent insect found in the East Indies, which makes a drumming which can be heard for a very long distance.

Family XI. **Fulgoridæ**. The Lantern and Candle Flies have a long head which is often produced into a spine or a bladder. The wings are generally coloured. The large species are natives of hot climates, and are now believed not to be luminous, as was formerly asserted.

Fig. gg. *Fulgora laternaria*, the largest species, is a native of South America, and is very remarkable for the immense protuberance on its head. The Indians believe that it can inflict a dangerous wound with its proboscis.

Fig. ff. *Dictyophora europæa* is an illustration of a European species with a somewhat similar excrescence.

Family XII. **Membracidæ**. In these insects, the head is vertical, or even bent downwards and inwards, and the prothorax is ornamented with large spines and protuberances. The fore wings are generally membranous.

Fig. ii. *Centrotus cornutus* is found in woods on ferns and bushes, especially hazel. It is dull black, with white hairs, and is about a quarter of an inch long. The wings are brownish hyaline.

Family XIII. **Cercopidæ**. The body is generally short, and the head horizontal. The larvæ suck the juice of low plants, and then discharge it, so that they are entirely surrounded with froth.

Fig. kk. *Aphrophora spumaria* is greyish brown with two yellow bands on the wings, and is very common, but it leaps so quickly that it is not easy to catch. Its froth-covered larva is called the Cuckoo-Spit, and is found everywhere on grass and bushes.

Fig. ll. *Cercopis sanguinolenta* is a pretty little red and black insect which is likewise common upon flowers and bushes. It is about a quarter of an inch long, and leaps very well.

Family XIV. **Aphidæ**. The Plant-lice are small soft little insects with oval bodies, filiform antennæ, with from 5 to 7 joints, and generally two short tubes at the extremity of the abdomen, through which they discharge a sweet fluid, which is known as honey-dew. They are found on the leaves of various plants in great numbers in spring and sum-

mer. These broods are wingless, and reproduce their kind asexually, and are much sought after by ants for the sake of the honey-dew. In the autumn, perfect males and females are developed, with delicate wings. The *Aphidæ* are very injurious to the plants which they infest, but have many enemies, especially the Ladybirds and Lace-winged Flies. They are also liable to the attacks of parasites.

Fig. mm. *Aphis rosæ* is a dark green species with raised wings, which is often seen in great numbers on the young shoots of roses, when the leaves curl up. The figure represents a wingless female.



Lachnus punctatus is an ashy grey insect, with a row of black satiny dots on the abdomen. It may be found in early spring on the shoots of the willow.

Fig. nn. *Schizoneura lanigera*, the American Blight, is one of the greatest pests to our apple-trees. The wingless females are covered with wool, and lay their eggs at the end of autumn, while some hibernate in the chinks of the bark. The young insects fix themselves to the branches, and drain the bark of the sap, especially in the case of the more delicate trees, in which the stems swell, the bark drops off, and the trees die. The colonies soon multiply a hundredfold, and cover the branches with their white wool. Many remedies have been suggested, some very simple (soap-suds, for instance).

Fig. oo. *Phylloxera vastatrix*, the Vine Aphid is also said to have been imported from America. It is a terrible pest, and destroys whole vineyards, and appears in two broods, one above and one beneath the ground. Other Aphides assume the winged form, and pair in autumn; but with this species it is different. Here the winged form is asexual, and gives birth to pupæ from which sexual forms are developed in autumn, which pair immediately, and lay eggs which do not hatch till the following spring. In April, the young Aphides climb to the leaves, and form small galls, in which they lie hid till June. After several moults and several broods, large egg-laying individuals appear in autumn, either from the subterranean or from the aerial brood, which either lay their eggs above ground under bark, or hibernate at the roots.

The *Phylloxera* beneath the ground suck the roots, causing knotty excrescences, and they multiply prodigiously through an indefinite number of generations if warmth and food do not fail them. It is very difficult to destroy them, as the winged forms carry the pest to other vineyards.

Family XV. **Coccidæ**. The Scale Insects have long antennæ, and a short proboscis only present in the female. The two-winged male undergoes a perfect metamorphosis, while that of the wingless female is incomplete. They are inactive plant-feeding insects, and some of the southern species yield a brilliant red dye.

Fig. pp. *Coccus Cacti*. We have figured the female of the Cochineal Insect. It is carefully reared in Mexico, South America, and the West Indies for the sake of the crimson dye which is obtained from it. The male is blood-red, with milk-white wings.

Section III. Anoplura.

The Lice are small insects with flat semitransparent bodies, in which there is no distinct division

between the thorax and abdomen. The antennæ are short, the eyes small, and the mouth is furnished with a retractile proboscis. They are parasites on the bodies of men and other animals, and lay their eggs (called nits) on the hair.

Pediculus capitis which lives in the hair of the human head, is pale grey. The female lays fifty

eggs, which hatch in six days; and the young lay eggs themselves in eighteen days more.

The Bird-Lice, as an example of which we have figured *Menops pallidum*, the Poultry Louse, belong to another section (*Mallophaga*), and are sometimes rather inappropriately placed among the *Neuroptera*.



Class Arachnida.

Plate XXIII (right side).

Wingless animals, without antennæ. The body is either separated into cephalothorax and abdomen, or is undivided. They breathe by means of lungs or tracheæ. The eyes are simple, but differ much in number and position. The skin is generally soft and leathery, and there are four pairs of jointed legs.

Most of the species live on land, though some are aquatic. Some feed on the juices of animals, and others are parasitic. Most of the species are voracious, and many are venomous. There is no metamorphosis, but they undergo a succession of moults.

Order I. Arthrogastra.

The abdomen is jointed, and fused with the rest of the body. The skin is hard, and the palpi resemble pincers or claws. The animals are carnivorous, and generally prefer dark places.

Family I. Scorpionidæ. The cephalothorax is shield-like, and the abdomen is cylindrical, jointed, swollen at the end, and provided with a curved sting, which has an opening at the extremity communicating with a poison-gland. The palpi are many-jointed, and terminate in pincers with which the animals seize their prey. They breathe through lungs, and produce their young alive. The largest and most venomous scorpions are found in hot countries, but there are a few small and comparatively harmless species in the South of Europe. One of these is

Fig. d. *Androctonus occitanicus*, which is brownish yellow, with the tip of the tail black. It is found on the shores of the Mediterranean, especially in South France and Spain.

Fam. II. Pseudoscorpionidæ. These are small nocturnal animals, with a cylindrical, many-jointed abdomen and pincer-like palpi. They are found in dry places.

Fig. c. *Chelifer cancrivorus* is reddish-brown with a broad abdomen, and is found among herbaria, in old books, and in similar situations, where it feeds on mites &c., and often attaches itself by its claws to the legs of flies, which thus convey it from place to place.

Family III. Phalangiidæ. In the Harvest Men all the portions of the body are fused together. The abdomen is jointed, and the legs are very long and slender. They have only two eyes, and no spinning-glands. They are nocturnal animals. The legs are easily broken off, and continue to jerk for some little time afterwards.

Phalangium opilio has a body about the size of a pea, and very long and slender legs, conspicuous pincers, and filiform palpi.

It is common everywhere, and feeds on small insects



Order II. Araneida.

In the Spiders, the jointed abdomen is separated from the cephalothorax. They have hooked upper jaws, no antennæ, a pair of pedipalpi, four pairs of true legs, more than two eyes, and one or more pairs of spinnerets on the abdomen. They are covered with a soft but tough skin, and they breathe by means of lungs or tracheæ. Spiders are to be found everywhere, and spin their webs in every corner. They prey upon living animals, which they either capture openly, or ensnare in their nets. They lay eggs, which are often found enclosed in very artificially-constructed cases; but the young spiders undergo no metamorphosis. They resemble the old ones, but grow very slowly.

Family I. Territellariæ. The Trap-door and Bird-eating Spiders have 4 spinnerets and 8 eyes. They are large and hairy, with large pedipalpi and

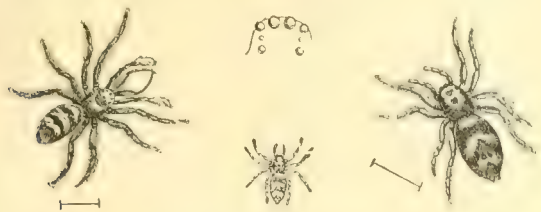
palpi. They live in burrows in the ground, which they line with silk, and often close with a trap-door, or else they live in crevices. They seize their prey by leaping upon it.

Theraphosa avicularia is a very large South American spider, which hides in hollow trees, and sometimes feeds on small birds. The body is short and very hairy, and the legs are very long and strong.

Family II. Citigradæ. The Hunting Spiders are of large size, and have 8 eyes and short hair. They live in holes, and leap upon their prey.

Fig. f. *Lycosa tarantula* is a large hairy spider, common in Italy and on the shores of the Mediterranean generally, which was formerly much dreaded for its poisonous bite, which was supposed to produce convulsive dancing.

Family III. **Saltigradæ**. The Jumping Spiders leap upon their prey, and drag them back to their nests.



Salticus scenicus is found about walls, and is often seen in sunny places very early in the spring.

Family IV. **Retitellariæ**. The Gossamer Spiders spin loose threads or net-like webs, and some of the species float about in them in autumn.

Fig. g. *Linyphia montana* makes its nest on fences or in old houses, or among heath.

Family V. **Tubitelariæ**. The House Spiders have 8 eyes arranged in 2 rows. They spin webs with cylindrical cells in which they catch their prey.

Fig. h. *Tegenaria domestica* is greyish brown with two brown streaks on the cephalothorax. The belly is ash-coloured, spotted with black. The male is smaller than the female. The web is purse-like, and is generally spun in a corner between two walls.

Argyroneta aquatica, the Water Spider, makes a silky nest in the water, in which it lives. The eyes in the middle are arranged in a triangle, and the lateral ones obliquely. It is found in stagnant or gently flowing water, where it makes its nest among the water-plants. The nest is bell-shaped, of the size of half a pigeon's egg, with the opening downwards.

The spider comes to the surface of the water to breathe, and when it climbs down again into the water along the plants, it is

surrounded with a silvery bubble of air, which is retained by the hairs of the body and a varnish-



like covering. This bubble it sets free in its nest, which thus gradually becomes filled with air, so that the spider can live dry in the water. It feeds on small water-animals.

Family VI. **Orbitellariæ**. In the Garden Spiders, the abdomen is large, and is furnished with 6 spinnerets. The nests are regularly formed of radiating and concentrically intersecting threads.

Fig. i. *Epeira diadema*, the Garden Spider, is a large rust-coloured spider, with a white cross bordered with black on the back; but it sometimes varies in colour. It makes very ingeniously constructed webs. In fine weather, the spider sits in the middle of its web, and rushes out to seize any insect which may have been caught, when it quickly entangles it in a



Bird-killing Spider (*Theraphosa avicularia*).

few threads, and then sucks it dry. In bad weather and at night it retires to some hiding place near the web.

Order III. Acarina.

The Mites are small, and often microscopic animals. The body is not divided, and the abdomen is not jointed. The body is generally oval, and is often provided with bristles or other appendages. The palpi are free, and composed of several joints, and the number of eyes varies according to the species. There are mites with 3 or 4 pairs of legs, of which the front pair is used for grasping. The mites hide themselves under stones and in moss, or on plants, animals &c. Some are parasitic, and a few spin a web.

Family I. **Trombidiidæ**. The Ground Mites are small red or yellow mites, with long slender legs. Some have no eyes, others have 2, 4 or 6, either sessile or stalked. They run rather fast. They are

found among moss &c. The young are generally parasitic on insects.

Family II. **Hydrachnidæ**. The Water Mites are very small, and are of aquatic habits.

Fig. k. *Hydrachna geographica* is very prettily marked with red. When young, it generally lives attached to the legs of the Water Skorpion.

Family III. **Gamasidæ**. The *Trombidium holosericeum* (magnified 80 diameters) body, and legs varying in length, with 4 claws at the ends. There are no eyes. They live parasitically on beetles, humble-bees, birds and reptiles.



Fig. l. *Gamasus Coleopteratorum* is an oval reddish brown mite, which is often found in considerable numbers on dung beetles and burying beetles.

Dermanyssus hirundinis, the Swallow Mite, lives in swallow's nests, and sometimes also attacks caged birds, pigeons and fowls. They hide themselves by day in the crevices of the nest or cage, and only attack the birds at night.

Family IV. **Tyroglyphidæ.** These are very small and mostly microscopic mites, with oval bristly bodies.

Fig. m. *Tyroglyphus siro*, the Cheese Mite, is white and brownish, and about one-twenty-fifth of an inch long. It swarms in old cheese.

Family V. **Sarcoptidæ.** The Itch Mites are parasitic in the skin of man and other animals, or live in decaying animal and vegetable matters.



Itch Mite (*Sarcoptes hominis*)
magnif. 8 diameters.

Sarcoptes hominis bores in the skin of man, and thus occasions the disorder known as the itch.

Family VI. **Ixodidæ.** The Ticks are of comparatively large size. The proboscis is large and prominent, and the skin of the abdomen is folded and extensile. They suck the blood of any animals which come to their way.

Fig. n. *Ixodes ricinus*, the Dog-Tick, is of a leaden grey, and as large as a hemp-seed. It lurks in grass and bushes, and when it attaches itself to the skin of a passing animal, it sucks the blood till it swells itself to the size of a small bean. It is easily got rid of by rubbing with oil.

Family VII. **Dermaphiliidæ.** These are microscopic animals, which are parasitic in the skin.

Dermodex hominis lives in the sebaceous cavities at the roots of hairs on the ears and nose of man.



Dermodex hominis
(magnified 600 diameters).

Class Myriopoda.

Plate XXIII (right hand).

These animals have long bodies composed of many nearly similar joints, each of which is provided with one or two pairs of legs. There is no division between thorax and abdomen. The head is distinct, and there are two antennæ. The eyes are rudimentary. They breathe by means of tracheæ. On quitting the egg, the creatures are without legs, or have only 3 pairs of legs, and increase the number of their segments and legs at each moult. They live chiefly in dark damp places, or under stones, and feed on decaying animal and vegetable matters.

Section I. Chilopoda.

In the Centipedes, each segment bears only one pair of legs. The antennæ are long. The bite of the larger species is venomous.

Fig. a. *Scolopendra morsitans* is brown, and the segments are of nearly equal length, the last with 3 spines. It lives in Central America, and is often brought to Europe in ships. Its bite causes great pain for a long time afterwards.

Fig. b. *Lithobius forficatus* is greyish-brown with a reddish lustre, and has 14 pairs of legs. The segments are of unequal size. It is found under stones and in the ground, and feeds on worms.

Section II. Chilognatha.

In the Millepedes the body is wormlike or much flattened, and every segment is provided with 2 pairs of legs. The antennæ are short, and 7-jointed. They feed on plants at night, and are found in all parts of the world. In Europe they are of moderate size, but in hot countries they often attain the length of nearly a foot.

Family I. **Julidæ.** These roll themselves up into a spiral form, and hibernate in this position.

Julus terrestris is ringed with yellow, and has



99 pairs of legs. It is found among dead leaves or under stones.

Family II **Glomeridæ.** These have long oval bodies, arched above, and 17 pairs of legs.

Fig. c. *Glomeris limbata* is of a shining blackish brown with yellow rings. It is a common species, and lives singly or in company under stones and fallen leaves.

Class Crustacea.

(Plate XXVII.)

Among the large numbers of existing animals we frequently meet with small groups which are extremely interesting to everyone who tries to trace out the relationships between the various forms of the animal kingdom, because they appear to be

related to more than one sharply defined group. Some of these are perhaps related to extinct groups, and are placed by naturalists with one class or another, as their views of their affinities vary.

We have now two such groups to consider,

both of which exhibit affinities with the *Crustacea* and the *Arachnida*.

The *Ecnogonidae* or Spider Crabs are sluggish spiderlike marine animals with slender bodies and four pairs of long slender legs, into which run prolongations of the intestine in a most remarkable manner. Most of the species are small, but we have given a representation of *Colossendus gigas* at fig. a, which is a very large species, with a straw-like body more than half-a-yard long, which is found in the Atlantic Ocean at the depth of 3,000 fathoms.

The **Pecilopoda**, or King Crabs are considered

to be related to the extinct Trilobites. They are large animals with an arched shield covering the head and thorax, which is jointed to a nearly hexagonal plate covering the abdomen, which is followed by a long movable and pointed tail. The limbs consist of 6 pairs of footjaws terminating in pincers, and 5 pairs of swimming and gill-feet. These animals inhabit the tropical seas, and are edible; they are sometimes to be seen in aquariums. *Limulus Polyphemus*, represented at fig. b, is a dark green species about two feet long. — The more typical *Crustacea* may be arranged in the following series:

Sketch of Orders of Crustacea:

Section I. Malacostraca.

Order I. Thoracostraca.

Suborder I. *Decapoda*.

Tribe I. *Macrura*.

Tribe II. *Brachyura*.

Suborder II. *Schizopoda*.

Suborder III. *Cumacea*.

Suborder IV. *Stomatopoda*. *

Order II. Arthrostraca.

Suborder I. *Amphipoda*.

Suborder II. *Isopoda*.

Section II. Entomostraca.

Order I. Branchiopoda.

Suborder I. *Phyllopoda*.

Suborder II. *Cladocera*.

Suborder III. *Branchiura*.

Order II. Ostracoda.

Order III. Copepoda.

Suborder I. *Copepoda natantia*.

Suborder II. *Copepoda parasita*.

Order IV. Cirripedia.

Suborder I. *Thoracica*.

Suborder II. *Rhizocephala*.

It is impossible to give a general description which would apply to all the *Crustacea*, for although everyone is familiar with crabs, lobsters and shrimps, yet there are other groups like the fish-parasites and barnacles, which have much more outward resemblance to worms or molluscs, and only betray their real relationship to the Crustacea in their metamorphoses. The forms which have not retrograded by parasitism have more than 4 pairs of legs, which easily distinguishes them from the other *Articulata*, and two pairs of antennæ, exhibiting great variations in form. They breathe by means of gills. Only

the Cirripedia (Barnacles) are hermaphrodite. When the young leave the egg, they seldom resemble the parents, but generally undergo a complicated metamorphosis; and in some cases, they are developed from unfertilised eggs. The three highest Orders, which show their close relationship in possessing the same number of segments in the abdomen, are classed together as *Malacostraca*. Many species are valuable as human food, and others play an important part in the system of nature as food for fish and other marine animals.

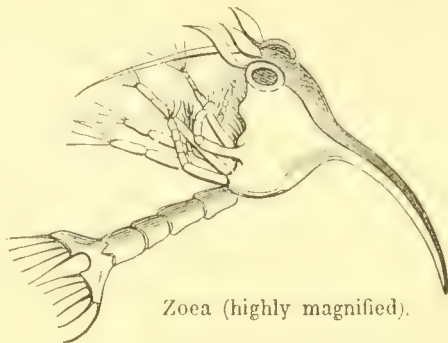
Section I. Malacostraca.

Order I. Thoracostraca.

The upper part of the body which consists of 13 amalgamated segments, is covered wholly or partially by the carapace, a large shield covering the head and thorax. The abdomen is composed of 7 segments, and the compound eyes are generally placed on moveable stalks. The different form and arrangement of the limbs in the various Orders forms a remarkable instance of the manysided developments which organs identical in origin may undergo in the course of development. The gills are appendages of the limbs, and are generally branching. If we dissect a crab or a crayfish, an easy and simple experiment, which will give us a good idea of the

anatomy of an articulated animal, we must first open the back (contrary to the usual process in the case of a vertebrate animal), when we first arrive at a long vessel which represents the heart; below this lies another vessel, the digestive apparatus, which has a sac-like enlargement (the stomach), which is bordered at the sides, and partially embedded in extensive glands. When we have removed all this, as well as the muscles, we find, sharply defined on the dark chitinous armour, a white thread-like organ with knot-like expansions which throw out slender threads laterally. This is the nervous system, which is not unlike a rope-ladder in form. In the crabs, the body

is foreshortened, and the nervous system is highly concentrated. In a few cases only, such as in the crayfish, do the young ones resemble the perfect animal when they quit the egg. More frequently, the newly hatched Crustacea exhibit a larval form called a Zoea, which has only a few pairs of limbs, and does not possess all the thoracic segments, but is furnished with peculiar spines, and is of almost microscopic dimensions.



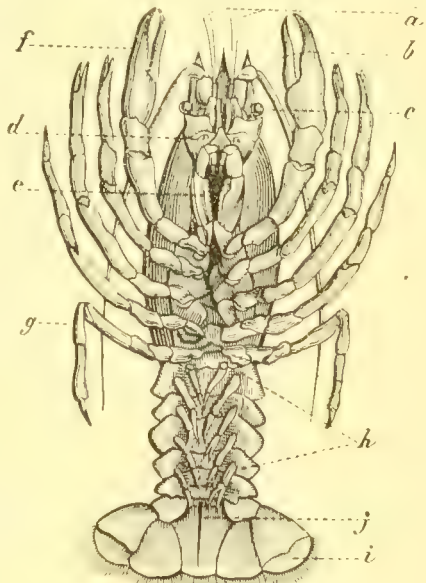
Zoea (highly magnified).

Suborder I. Decapoda.

The carapace completely covers the head and thorax in one piece. 3 of the 8 pairs of thoracic legs are converted into foot-jaws, leaving 10 legs fitted for walking. There are two sharply defined sections, in one of which the abdomen is reduced to a mere plate, while in the other it is well developed, and nearly as large as the rest of the body.

Tribe I. Macrura.

Fig. c. *Astacus fluviatilis*, the Cray-fish, may be taken as the typical illustration of the section in which the abdomen is well developed. The accompanying figure represents the undersurface. The last pair of abdominal legs is expanded into plates, and forms a kind of tail-fin (*i*). The first pair of walking legs is armed with large pincers, and the second and third pairs have also pincer-like terminations, which is a character of the family *Astacidae*, to which the crayfish belongs. This wellknown animal is of a dark brown colour, and is found everywhere in Europe on rivers and streams under stones and in holes on the banks, and feeds on animal matters. The calcareous masses called "crabs-eyes" are outgrowths from the surface of the stomach. The redness caused by cooking is due to the destruction of the brownish colouring matter of the shell, which develops a second layer of red colouring matter.



Female Crayfish (lower surface).

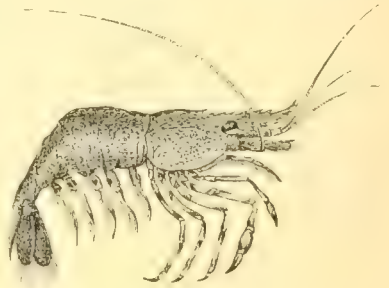
a) Inner antennæ. b) Outer antennæ. c) Eyes. d) Auditory organs. e) Foot-jaws. f) First pair of legs. g) Fifth pair of legs. h) Abdominal appendages. j) Vent. i) Outer scale of tail-fin.

Fig. d. *Homarus vulgaris*, the Lobster, is very like the Crayfish, but is much larger, and lives in the European seas; a nearly allied species is found on the coast of North America. The Lobster is caught in baskets, into which it creeps during the night. Its importance as an article of food may be

estimated by the fact that about 13 millions are annually consumed in Europe and in North America.

Fig. e. *Palinurus vulgaris*, the Spiny Lobster, represents the family *Loricata*, in which the five pairs of legs do not end in pincers. The outer antennæ are longer than the body, and their basal joints are thick and spiny. It is common in the European seas, and sometimes attains a weight of six pounds. Its flesh is more esteemed on the coasts of the Mediterranean than in England.

In the family *Caridinidæ*, which includes the Shrimps and Prawns, the cephalothoracic shield is generally produced into a large beak, and the first 2 or 3 pairs of legs frequently end in small pincers. Enormous numbers of the common shrimp (*Crangon vulgaris*) are swept up with nets on the sand in shallow water, as well as Prawns (*Palaemon serratus*) which are larger, and armed with a strong frontal spine.



Prawn.

In the Hermit Crabs (*Paguridæ*) the abdomen is extremely soft, and therefore the animals shelter themselves in shells, which they trail about after them. The first pair of legs ends in two pincers of unequal size. One of the commonest species is *Pagurus Bernhardus* (fig. f), which shelters itself in whelk-shells.

Tribe II. Brachyura.

In the Crabs the abdomen is short, and is curved under the hollowed undersurface of the shell, so that the body is often broader than long. The first pair of legs is provided with claws. Some crabs are able to live on land and climb trees, though most of them live in the sea. They run quickly, but always sideways.

Fig. g. *Gecarcinus ruricola*, the Land Crab, may be taken as a representative of the crabs with a square shell. It is found in the West-Indian Islands, where it lives in holes some miles from the sea. It is about eight inches broad.

Other genera of this section are marine. The species of *Pinnotheres* are found between the valves of different bivalve shells, especially *Pinna*.

Fig. h. *Cancer pagurus*, the Edible Crab, belongs to another group, with a broad shell, rounded in front. It sometimes attains a breadth of fifteen inches and a weight of six pounds.

Fig. i. *Maia squinado*, the Spider Crab, has a triangular pointed carapace, and is covered with spines and shaggy hair. It is very common in the European seas.

Suborder II. Schizopoda.

In this group, the three first pairs of legs are not true footjaws, but are used for walking, and like the other legs, are biramous and bristly. The abdominal legs are generally rudimentary in the female, but are used for grasping organs in the male. The few species belonging to this group are all inhabitants of the open sea, and some, as the genus *Mysis*, are parasitic on whales in all stages of their existence. They resemble shrimps in form.

Suborder III. Cumacea.

The chief character of this small group is that the last 4 or 5 thoracic segments are not covered by the carapace; the abdomen is long, and the eyes are wanting, or reduced to a pair of mere rudiments. Most of the species inhabit the Northern Seas.

Suborder IV. Stomatopoda.

This is a small but well-marked group, which exhibits a superficial resemblance in form to some *Orthoptera*.

Order II. Arthrostraca.

The species of this Order agree with those of the last in the number of segments (20) into which the body is divided, and of paired extremities (19), but they differ in the absence of a carapace. The eyes are not placed on stalks, but on the body itself. There is no metamorphosis, and the eggs are carried about by the female in cavities formed by appendages of the thoracic legs. They are small creatures, and many of them are land-animals.

Suborder I. Amphipoda.

The body is laterally compressed, the front pairs of thoracic legs often end in grasping-claws, the three first pairs of abdominal legs are swimming feet, and the three next are penicillate. The species are very numerous.

Fig. o. *Gammarus pulex*, the Fresh-water Shrimp (which name is sometimes improperly applied to the larvæ of the *Dytiscidæ*) is common in fresh water, and is frequently used as food for other animals kept in aquariums. It is called *pulex*, "the Flea" from its peculiar jerking movements. The allied species found on the sea-shore are called sand-hoppers.

The *Phronimidæ* are distinguished by their wide head, the great pincers on the fifth pair of legs, and their habits. They inhabit the bodies of *Salpidæ*, in which they swim swiftly about in the sea. One species, *P. sedentaria*, is represented at fig. l.

The *Caprellidæ* also exhibit very strange shapes. They are characterised by their very slender form, and by the rudimentary abdomen, which is reduced to a jointless protuberance. *Caprella spinosissima*, a very remarkable species from the Northern seas, and which is covered with spiny protuberances, is represented at fig. m.

The *Cyamidæ* resemble the *Caprellidæ* in the rudimentary abdomen, but are totally different in

Fig. k. *Squilla mantis*, which inhabits the Mediterranean, is one of the best known species. Its long body resembles that of the *Decapoda*, from which it is at once distinguished by the carapace, which leaves the four last thoracic segments exposed. No less than five pairs of legs are modified into foot-jaws for seizing and tearing prey, and the second pair is furnished with a powerful dentated hand for striking and grasping. The three other pairs of legs serve for walking, and are cleft, and the abdomen is furnished with swimming-legs.

form and habits, being parasites on the skin of whales. *Cyamus ceti*, the Whale-Louse, is represented at fig. n.

Suborder II. Isopoda.

The body is vertically compressed, and the thoracic legs are uniformly adapted for walking or clinging. The organs of respiration are placed in delicate layers above the five terminal legs.

The *Oniscidæ*, or Wood-Lice, are found on land in damp places, and the external plates of the abdominal legs form strong covers. The first pair of antennæ is very small, and not visible from above. Two species are figured: *Oniscus murarius*, fig. p., and *Porcellio scaber*, fig. q.

In the allied genus *Armadillo*, the species roll themselves up into a ball. Several species of *Oniscidæ* are water-animals. *Asellus aquaticus* is an inhabitant of fresh water, but most of the species are marine, including *Limnoria terebrans*, which bores in timber.

The *Cymothoidæ* may be known by their short abdomen, grasping legs, and large size. They attach themselves by the sucking parts of their mouth to the skin or within the mouth of fishes. *Ceratothoa trigonocephala* has been figured as a representative of this family (fig. r).

The *Bopyridæ* are the first family to exhibit the influence of parasitism, which proceeds to such an extent as to obliterate all characters of its class in the mature animal, so that nothing but the course of its development indicates its Zoological position. At the same time the sexes differ greatly, as the very small unattached males preserve the appearance of woodlice. The large females which live parasitically in the gill-cavities of shrimps, or the body-cavities of crabs, lose their eyes and the segmentation of the body, and look like ugly swellings or tubes.

Section II. Entomostraca.

The lower groups of the *Crustacea* are placed together under this name, although there is no general character which will apply to all the very different forms which are included under it. They all agree, however, in their development, for they undergo metamorphoses, and quit the egg in the so-called *Nauplius* form, which is the same in all the *Ento-*

mostraca, no matter how different may be the fully-developed animals. The freely swimming larvæ called *Nauplius*, have an oval body, a single eye on the forehead, and three pairs of limbs. They pass through numerous changes of form before reaching the final stage of their development.

Order I. Branchiopoda.

The legs are provided with leaf-like gills, which serve for respiration. The eyes are sometimes simple and sometimes compound eye-points. There are great differences in other respects in their form and structure, especially as one subdivision is parasitic, although most of the species of the order swim freely in the water.

Suborder I. Phyllopoda.

In the *Phyllopoda* the body is distinctly segmented. Among the interesting species which it includes, is *Artemia salina*, the Brine Shrimp (fig. t). It is a small long shell-less creature with 11 pairs of leaf-like gill-feet, and a many-jointed abdomen, and is not found only in the sea, but also in artificial salt-pits, and can adapt itself to the amount of salt in its surroundings to an amazing extent. Another species of this group, *Apus cancriformis* (fig. u) is about 2 inches long, and has a flat curved shell, 40 pairs of legs, and two long terminal threads on the abdomen. It lives in rivers and streams, and sometimes appears in great numbers after violent storms. When its residence is dried up, it disappears sometimes for years, and reappears quite suddenly.

This is owing to the fact that its eggs are laid in the mud, and retain their vitality for many months.

Suborder II. Cladocera.

The few minute animals classed here have an unjointed body, generally enclosed in a bivalve shell, and their dancing movements are caused by large oar-like organs, as well as by their swimming-legs. These organs consist of the modified outer antennæ.

Fig. v. *Daphnia pulex*, the Common Water-flea, lives in standing water in such swarms in spring and summer as often to colour it red. In winter, the animals die, leaving their eggs behind them. One very long species is *Leptodora hyalina*, which is completely transparent, and invisible in water.

Suborder III. Branchiura.

A few fresh-water species are included in this division, one of which, *Argulus foliaceus*, the Carp Louse, is represented at fig. w. The four long cleft legs and large eyes show that this animal is not a permanent parasite, and it is now known to stray from one fish to another, where it fixes itself by its tube-like mouth, which is set with sharp teeth.

Order II. Ostracoda.

The body of these small Crustacea is entirely enclosed in a bivalve shell. The antennæ and the hinder pair of legs serve as swimming organs, and the animals dart about in the water with great

agility. Species of the genus *Cypris* (*C. fuscus* is represented on fig. x) are nearly always to be found if looked for in summer. They are about the size of a pin's head. Other genera are found in the sea.

Order III. Copepoda.

This Order is divided into two sections, which it will be well to discuss separately.

The free-swimming *Copepoda natantia* may be easily studied in the genus *Cyclops*, which is a common inhabitant of fresh water. They may be distinguished from the *Ostracoda*, in whose company they are met with, by the jointed shell-less body, and the females may be known by the two egg-sacs which are appended to the abdomen. These pretty little animals are an important addition to the food of fish; and their marine allies, *Cetochilus*, are met with in vast multitudes, and form the chief food of the whale.

The creatures belonging to the second suborder, *Copepoda parasita*, are very different indeed in appearance. Ugly as they are, they are interesting as furnishing a striking example of the adaptation

and retrogression of disused organs. Even these parasites quit the egg as a *Nauplius* with an eye and limbs, and swim about, but as soon as the female (which alone is parasitic) finds her way into the gills or other organs of a fish, she grows rapidly, and loses all her limbs. The eye and limbs have become useless, and retrograde; the body loses its segmentation, becomes bag-like, and acquires all kinds of strange-looking excrescences. While the parasitic females grow large, and sink to a lower level in the animal kingdom, the males remain small, but retain their segmentation, limbs, and organs of sense, and attach themselves parasitically to the body of the female. In the *Lernæidæ*, the female, even before the ovaries are developed, surpasses the male 3000 times in bulk. One of these strange female forms, *Lernæa branchialis*, is represented at fig. y.

Order IV. Cirripedia.

Plate XXIII (left side)

Suborder I. Thoracica.

Although most of the species belonging to this section are not parasitic, yet they exhibit little outward resemblance to the more typical Crustacea. Here also the young exhibit the true *Nauplius*-form, but the developed animals fix themselves to various

objects by the head, and become surrounded by a shell consisting of one or several pieces. The body is not jointed, and the limbs are modified into branching organs to sweep the water into currents, and thus to draw food between the shells. These animals are hermaphrodite. They are called Barnacles.

Fig. p. *Lepas anatifera* is to be found every-

where in the sea, attached to all sorts of fixed or movable objects; rocks, ship-keels &c. It used formerly to be imagined that the Barnacle Goose was developed from this creature.

The species belonging to the *Balanidae* are fixed without a stalk. *Balanus tintinnabulum*, fig. q, is found in abundance attached to ships returning from the Southern Seas; and *Coronula balcanaris*, both surfaces of the shell of which are represented at fig. r 1 & 2, is parasitic on the skin of the whale.



Nauplius
Larva of *Lepas
anatifera*.

Suborder II. Rhizocephala.

These animals are degraded to the utmost by parasitism. Those of the genus *Peltogaster* lose the segmentation of the body, the organs of sense, the limbs, and even the cavities of the mouth and the intestine, and become a mere tube attached to the abdomen of the *Decapoda*, while they absorb its juices by root-like threads. Here, too, the initial *Nauplius* form indicates the real affinities of the animal. A creature of the degraded type just described is represented at Fig. s (*Sacculina carcini*).

Subkingdom Mollusca.

I. Tunicata.

Plate XXII (left side).

These are marine animals of a bag-like or barrel-like shape. The leathery or cartilaginous and often transparent bag contains a second loosely suspended in it, with a thinner integument, containing the organs of the animal. At each of the two points

where the inner bag is connected with the outer, there is an opening to admit of a current of water. These creatures are hermaphrodite, and often pass through a rather complicated metamorphosis.

Class I. Thaliacea.

Freely swimming species of baglike or barrel-like form, with a transparent outer covering. The two openings of the mantle are close together. Some are found swimming freely in the open sea, and others are found linked together in chains; and yet both forms belong to the same species. The chain-like animals produce young which swim freely about.

Some reproduce their kind asexually by budding, and form new animals which remain linked together into chains; and then lay eggs again. This kind of reproduction is called alternation of generations. Such a chain is shown at Fig. n, which represents *Salpa zonaria*.

Class II. Ascidia.

Most of these animals are bag-like in form, and the two openings of the mantle lie close together. Their development is very interesting, for they possess an organ, the spinal cord, which occurs elsewhere only in Vertebrata.

Fig. o. *Cynthia ramus* is a species which often founds colonies, and becomes a compound ascidian. Sometimes the colonies become spongelike and over-

grow foreign substances like a crust, and some exhibit the form of a hollow fir-cone, on the outside of which the separate animals are placed.

Fig. p. *Pyrosoma atlanticum* is one of the latter. It swims freely in the sea, emitting a beautiful light, and is one of the numerous animals which occasion the luminosity of the sea.

II. Mollusca (typical).

In the numerous animals properly included under this heading, the body is unjointed, and there are no limbs. They are enabled to move by means of a powerful muscle on the abdominal surface of the body, called the foot. There is no movable skeleton, either external or internal, but there is generally a calcareous shell formed of one or two parts, which quite encompasses the body. In the higher Mollusca the front part of the body forms a more or less distinct head, which in one class is

surrounded by a fringe of arms. There is a nervous system, in addition to well-developed organs of sense. The intestine is divided into several sections, and there is a plate in the mouth-cavity set with delicate teeth. They generally breathe with gills. The sexes are sometimes separate, and sometimes the animals are hermaphrodite. The species are mostly aquatic (in general, marine) and even the land-molluscs prefer damp places.

The *Mollusca* are divided as follows:

Class I. **Cephalopoda.**Order I. *Tetrabranchiata.*II. *Dibranchiata.*Class II. **Heteropoda.**Class III. **Pteropoda.**Class IV. **Gastropoda.**Order I. *Branchiata.*II. *Pulmonata.*Class V. **Lamellibranchiata.**Class I. **Cephalopoda.**

Plate XX (left side).

The Cuttle-fish have a well-defined head, surrounded with a series of sucker-bearing arms. They have eyes resembling those of vertebrate animals, which distinguish them at once from all other Molusca. On the abdominal surface of the body is situated the funnel, through which ink is discharged in some species. The shell is often absent or concealed, and the mouth is armed with naked horny

jaws, like the beak of a parrot reversed. The sexes are separate, and one arm of the male is modified into a copulatory organ, and is frequently so greatly modified that it preserves its power of motion for a long time, and was formerly supposed to be a distinct animal, and described under the name "Hectocotylus". The Cuttle-fish breathe by gills, of which there are either two or four.

Order I. **Tetrabranchiata.**

These Cuttle-fishes are provided with four gills and many movable tentacles on the head without suckers. They were a very important group in the former history of the world, and their petrified shells are known everywhere under the name of Ammonites. They are represented now by a single genus.

Fig. a & b. *Nautilus pompilius*, the Pearly Nautilus, is figured entire and in section. The section shows it to consist of separate divisions (chambers).

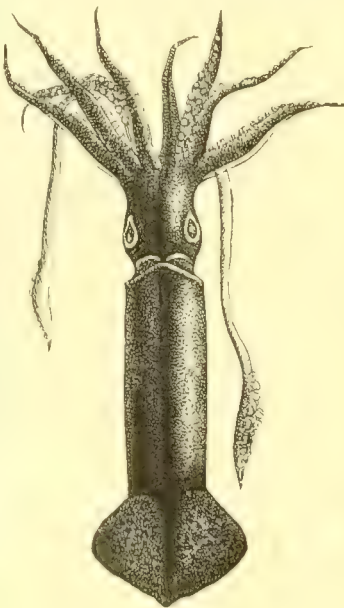
The outermost is inhabited by the animal, and the others are filled with air, but they are all connected by a tube-like process called the Siphon, which penetrates the walls of separation. The shells of the extinct ammonites are constructed in a similar manner, and in these lines of growth of the walls of separation with the shell often exhibit very delicate moss-like ramifications.

Order II. **Dibranchiata.**

These are now represented by a large number of living genera and species. Instead of tentacles, the head is surrounded by 8 or 10 sucker-bearing arms. A few forms only possess a shell,

which is generally covered with the mantle. Most of them are provided with a horny or calcareous plate on the back, the cuttle-bone. They have the peculiarity of changing their colour, and pass rapidly through a whole series of changes; red, blue, yellow and dusky. All the *Dibranchiata* are furnished with a peculiar organ called the ink-bag, which secretes a deep black fluid, from which the black pigment known as *Sepia* is prepared.

Fig. c, *Sepia officinalis*, the Common Cuttle-fish, belongs to the group with 10 arms, of which

*Loligo Brogniarti.*

two are considerably longer than the others. The allied genus *Loligo* is distinguished by its horny shell and long body. We have figured *Loligo Brogniarti*. Another species, *Loligo vulgaris*, is eaten by the lower classes in Italy.

The species of *Sepia* and *Loligo* are mostly coast animals, though they can swim well; but there are other Cuttle-fish, some of gigantic size, which inhabit the open sea. The fossils called "Belemnites" are the bones of extinct species of 10-armed *Dibranchiata*. There is another group on which the two long arms found in *Sepia* &c. are absent. They have only 8 strong sucker-bearing arms, with which they seize their prey, and they do not hesitate to attack and destroy animals such as lobsters, which would seem to be much stronger than themselves. They generally hide in clefts of the rock, and dart out like lightning to seize their prey. In swimming the hinder end of the animal is moved forwards.

Fig. d, *Octopus vulgaris* is typical of the 8-armed Cuttle-fishes.

Fig. e, *Argonauta argo*, the Paper Nautilus, is one of the few *Dibranchiata* which possesses a shell. This, however, is met with in the female only; the male is smaller, and is without it. The animal itself is very handsome when it grasps the delicate paper-like shell with the fin-like expansions on the back of the arms. It inhabits the Mediterranean.

Class II. Heteropoda.

This Class includes a few small species which inhabit the open sea. The foot is laterally compressed, and resembles a keel; it is very movable, and serves as a rudder. Behind the keel, we find a sucker which the animal uses to attach itself to seaweed, and other floating objects. In front of the keel is the head, which projects like a muzzle, and is provided with strong teeth. The intestines are rolled into a coil. The sexes are separate. Some

species are entirely destitute of a shell, and are quite transparent, so that the darker intestinal portion is all that is seen of the animal as it moves through the water; and others have a thin shell into which they can retreat entirely, closing it with a lid attached to the tail-like extremity of the animal.

Plate XXI. fig. u. *Atlanta Peronii* is a small species which swims in shoals in the open Mediterranean Sea.

Class III. Pteropoda.

These are small animals found on the open sea, which are provided with two large wing-shaped fins. They are hermaphrodite; the head is not distinctly defined, and they have no well-developed organs of vision; but the mouth is furnished with jaws and teeth, and is sometimes surrounded with tentacle-bearing suckers. Some are naked, and others

provided with a shell, but they are all able to sink quickly to the bottom of the water by drawing in their fins. We have figured *Clio borealis* (Plate XX. fig. f) a common species in the Northern Seas, which largely contributes to form the food of the Greenland Whale.

Class IV. Gastropoda.

These are much more familiar animals than the *Pteropoda*. A snail is at once recognised as possessing tentacles with eyes, a broad foot on which it creeps, and a shell. In the Slugs the shell is wanting. We may add that the shape and size of the foot is very variable, and that most of the species have a well-defined head. The form of the tongue and the different arrangement of the teeth are great aids to their classification. The larger divisions of *Gastropoda* are characterised by the

structure and position of the organs of respiration, which are either gills or lungs. In some, the sexes are separate, and others are hermaphrodite. Only a few species are viviparous. Most of them lay eggs; either laying a few large ones surrounded by a shell, or depositing spawn in gall-like clusters and strings. The majority are marine; but many are found on land, or in fresh water. Their food is very various; some feed on plants, others on dead animal matters, and others again are carnivorous.

Order I. Branchiata.

Plate XX (right side).

This Order is divided into two sections according to the position of the gills, and other characters. In one small group the gills open behind the heart. These animals are hermaphrodite, and usually shell-less. There are sometimes tufted appendages on the skin. We have figured two species of this section.

Fig. g. *Eolidia carulescens* is remarkable for its delicate colour.

Fig. h. *Aplysia depilans* is called the Sea Hare, from the shape of the second pair of tentacles. The eyes are placed between the two pairs of feelers. The animal is common on the southern and western coasts of Europe, and discharges a dark violet fluid, which was regarded by the ancients as a poison.

The greater part of the *Branchiata* belong to the second section, in which the gills are placed before the heart. They are all provided with a shell, and the sexes are separate. The eggs are often laid in capsules, which are then fixed to foreign substances. The beautifully-coloured shells are much admired by collectors of curiosities, and large prices have often been paid for a single shell. It is perhaps only natural that more attention should have been paid to the form and colour of the shells, than to the anatomical structure of the animals which inhabited them.

The shell is a secretion from the outer integument of the body, the mantle, and consists of carbonate of lime. The opening of the shell is called the mouth and its circumference the lip, while its coil is called the whorl. Many water-snails have a horny or chalky lid on the back of the foot, with which they can completely close the shell; and land-snails close their shells in a similar manner in winter.

We have given two illustrations of the group in which the leaf-like gills are arranged in a circle.

Fig. i. *Patella granatina*, one of the Limpets, is characterised by a smooth plate-like shell, which clings with wonderful firmness to rocks and stones. The eyes are placed at the base of the two pointed tentacles, and the gill-plume is spiral and very long.

Fig. k. *Chiton squamosus* resembles a wood-louse in form, and as the shell consists of 8 jointed plates, it can roll itself into a ball like some of these animals. They resemble the Limpets in their habits, and cling to rocks in the same way.

Many species exhibit comb-shaped gills.

Fig. l. *Halotis Iris*, the Ear-shell, derives its name from its shape; the inside is beautifully iridescent. This shell is pierced with a number of holes, through which the animal protrudes thread-like appen-

dages of the foot. The head terminates in a short non-retractile muzzle, with long tentacles and short stalked eyes. The three following species belong to the same family.

Fig. m. *Trochus marmoratus*; fig. n. *Turbo olearius*, and fig. o. *Nerita exuvia* are three shells from the Eastern Seas which are very unlike in appearance. *Trochus* has a conical shell with a lozenge-shaped mouth, while *Turbo* has a round one.

The Wentle-Traps (*Scalaria pretiosa* fig. p and *S. communis* fig. q) represent another large group, in which the shell is thick and spiral. The mouth is oval, and the outside is adorned with vertical ridges. The first species is European, and the second Indian. The animals have 4 long slender tentacles at the base of which the eyes are placed; the tongue is armed with rows of numerous small teeth.

There is a large group of shells distinguished by a long retractile proboscis. The animals are all carnivorous and some possess shells of beautiful shape and colour.

Fig. r. *Voluta æthiopica* is a thick shell with a short whorl, and a deep excavation for a tube (or siphon) leading to the gills.

Fig. s. *Harpa ventricosa*, the Harp Shell, is an inflated ridged shell with a short whorl.

Fig. t. *Mitra episcopalis*, the Mitre Shell, is a native of the East Indies.

Plate XXI (left side).

Fig. a. *Murex trunculus*, the Rock-shell, has at least three rows of swellings and spines. It is sometimes eaten, and its operculum was formerly used in medicine. The allied genus *Purpura* was

once of far greater value, as the source of the costly Tyrian Purple dye; but its use has now been replaced by that of aniline dyes.

Fig. b. *Conus ammiralis* represents another large genus of shells. The tongue is set with two rows of long hollow teeth, which can be darted out of the mouth like arrows.

The last group of the marine *Branchiata* which we shall notice have a ribbon-shaped tongue, two tentacles, and spiral shells. In the Cowries (*Cypræa*) the shell is oval, the mouth is long and deeply ridged on both sides, and the lips are recurved.

Fig. c. *Cypræa tigris* is a fine showy species, but *C. moneta* (fig. d) is of greater importance, as it has been used throughout Africa as money from time immemorial. Whole caravan-lords are annually sent from Zanzibar into the interior of Africa, and on the West Coast a great trade is carried on with cowries, which are said to be worth about 700 to the shilling.

Fig. e. *Tritonium nodiferum* is a long shell with raised circular ridges. In old times it was used as a trumpet.

Fig. f. *Cassis tuberosa*. In this species the whorl is short, the last curve of the wide shell is large, and the opening narrow.

Fig. g. *Dolium galca*, a native of the Mediterranean, presents opposite characters, for the shell is thin, and the mouth wide.

Fig. h. *Strombus auris Dianæ* and fig. i. *S. pugilis* have a pointed whorl, and the outer lip has a broad wing-shaped expansion. In the animals the foot is divided into two parts, opposed to each other, and the animal is thus enabled to leap.

Order II. Pulmonata.

These lung-breathing molluscs are inhabitants of the land and of fresh water. The trachea is connected with a network of vessels, and opens externally on the right side. The heart lies behind the lungs. They are all hermaphrodite, and most of them lay eggs. The eyes are situated either at the extremities of the tentacles, or at their base. The first group is illustrated by the 4 following species.

Fig. k. *Limnæa stagnalis*, the Water-Snail, is a dull-coloured species which is very common in stagnant water. In some of the allied species found in the same localities, the whorl of the shell is shorter and the mouth is larger. The animals creep on plants, or swim on the surface of the water with the shell downwards, and the foot upwards. The white gall-like clusters of eggs are often to be seen fixed to water-plants.

In the genus *Planorbis*, the shell is rolled into a flat disc. They are found in the same localities as the Water Snail. The commonest species is *Planorbis corneus* (fig. l). In a smaller kind (*P. carinatus*, fig. m) the shell is ridged.

Fig. n. *Scarabus imbricum* has a thick shell, and lives in damp places, where it sometimes makes its appearance suddenly in large numbers.

The Slugs have 4 retractile tentacles, the hinder pair of which are furnished with eyes at the tips. The shell is reduced to a small rudiment beneath the skin. They are land animals, and are found in damp places. We have figured two species, the Garden Slug (*Limax hortensis*, fig. p) and the Red Slug (*Arion rufus*, fig. o). The latter is common in woods.

The second division of the *Pulmonata* includes the shell-bearing snails. They have 4 tentacles with eyes at the tips, and large spiral shells in which the coiled intestines extend to the tip, and into which the animal can completely withdraw itself.

Fig. q. *Pupa uva* belongs to the smaller species, in which the shell is cylindrical, and (in the species figured) ribbed. They are found under moss, and several species are viviparous.

Fig. r. *Bulimus decollatus* has rather a curious habit, for as the animal grows, it withdraws itself from the last coil of the whorl, and closes it by a partition, when the empty coil falls off, and leaves the shell sharply truncated. This species inhabits Southern Europe.

Fig. s. *Helix pomatia*, the Edible Snail, represents the important genus *Helix*, in which the whorl of the shell is all but invariably turned to the right. In autumn the snails retire to their winter-quarters under moss, and close the shells for six months with a calcareous operculum. The snail is considered fit for food as long as it is closed, and is eaten in large quantities in many parts of Europe.

Fig. t. *Helix nemoralis* is abundant in England, where the Edible Snail is scarce; and although it is a very variable species, it may be recognised at once by its chestnut-brown lip.

Plate XXII. fig. i. *Dentalium vulgare* is a curious shell found on the coasts of Western Europe, which resembles an elephant's tusk. The shell is completely filled by the living animal, but is generally found empty, as the creature buries itself in the sand.

Class V. Lamellibranchiata.

Plate XXI (right side).

The Bivalves are distinguished from the Snails by possessing a shell formed of two valves which are smooth and iridescent on the inner surface. The outside consists of a dark brown horny integument. Between the two longitudinal layers lies a strong calcareous layer, composed of cells of lime placed close together like those of a honeycomb. When we open a living mollusc, we first find a fold of integument lining the inside of each valve of the shell. This is the mantle, which is followed by two layers or plates on each side, the gills. Between these again is the body of the animal, round which is folded the strong muscle called the foot, which is protruded from between the shells for purposes of locomotion. No head is visible; the opening of the mouth is invisible; and as the animals feed only on microscopic organisms, there is no need for either jaws or teeth. On each side of the mouth stands a pair of three-sided tentacles, which are set with microscopic cilia like the gills and the inner surface of the mantle, which give rise to currents which supply the animal with food. Among the other organs we may mention the liver, and intestine; and the nervous and vascular systems &c. In most species, the sexes are separate, and they lay eggs which pass through a portion of their development between the gill-laminæ. The valves are closed by one or two strong muscles, which leave their impressions upon them; and are opened by the elastic ligament at the back of the shell, which also serves to bind the valves together. The valves are frequently connected by a system of teeth or notches fitting into corresponding depressions on the other side. As the ligament exists after the death of the animal, all dead shells gape. All the Bivalves are water-animals, and most of them are marine. A few swim, but most creep on the ground, or bury themselves partially in it. Many fix their shells on the rocks, and some attach it by a band of silk-like threads, which is called a byssus or beard. In many bivalves two projecting tubes called siphons rise from a peculiar elongation of the hinder portion of the mantle. The Bivalves are classified by the presence or absence of these, in conjunction with the number of clasping muscles, and their impressions on the inside of the valves.

I. Bivalves without siphons.

Fig. d. *Ostrea edulis*, the Oyster, is familiar to everyone. The convex shell is fixed to the rock, and the flat shell covers it like a lid. There is no foot, for the animal is incapable of free motion. In the middle of the shell is the imprint of a single large clasping muscle. The animals assemble in colonies called oyster-banks. The oyster was a favourite food in prehistoric times, and is so still, but at present it is rather a delicacy than a staple article of food for our more numerous populations, although it has been artificially reared since Roman times. This is partly effected by artificially stocking bays with the young brood, and partly by removing oysters from the natural beds to so-called "oyster-parks", where they are fattened. The most esteemed oysters are the English "natives", and those of Normandy, Brittany, and Holstein, and in America, the closely-allied Virginian Oyster. They are not found in the Baltic Sea. The annual consumption

of oysters for human food must amount to many millions, and oysters are also preyed upon by many marine animals, such as star-fish, shells, sponges &c., which work great havoc among the oyster-beds.

Fig. b. The Scallop (*Pecten maximus*) is another well-known bivalve of delicate flavour, and its shells were formerly placed by pilgrims in their hats. The animals, which have only one clasping-muscle like the oysters, swim actively about by opening and closing their valves.

Fig. c. *Spodilyus gaedarepus* is a Mediterranean species which differs from the Scallop by the long spines placed on the longitudinal ridges, and in its habits, as the right hand shell is never firmly closed. Thanks to the spines, the beautiful shell is frequently covered with a thick mass of dirt and Algæ.

Fig. e. The Pearl Mussel (*Meleagrina margaritifera*) is another valuable shell. It is chiefly found in the Indian Ocean and in the Persian Gulf, and is sought after for the precious excretions of the mantle called pearls. In China they attempt to accelerate the production of pearls by artificial injuries inflicted on the mantle. The inner layer of the shell, called mother-of-pearl is also an article of trade. These animals have two clasping-muscles, but the first is so small that its impression in the shell is hardly visible.

Plate XXII. fig. a. *Malleus vulgaris* is another East Indian shell. It is remarkable for its hammer-like form; and is laminated like the shells of the oyster and the pearl-mussel.

Plate XXI. fig. f. *Pinna nobilis* attaches its shell to a rock by a reddish-brown tuft of threads, or byssus. From this, the Italians manufacture gloves, purses &c. The shells are sharply triangular, and gape behind. There is the impression of a small muscle in front, and of a large one at the back.

Fig. h. The Mussel (*Mytilus edulis*) is found attached to wood and stone-work as well as to rocks in enormous masses in all the seas of Northern Europe. It is not so much eaten now as formerly, because it is sometimes poisonous. In this species also the impression of the front clasp-muscle is smaller than that of the hinder one.

Fig. g. In the Noah's Ark Shell (*Arca Noë*) the clasp-muscles and their impressions on the shell are of equal size. The thick shell exhibits very complicated toothings on the margins.

The Fresh-water Mussels form the last family of the bivalves without siphons. They are found in rivers, brooks and ponds, and generally rest with the front buried in the mud, or creep slowly at the bottom of the water. The shells are oval, and the valves are of similar size and shape, and are covered externally with a strong brown epidermis, and are lined within with mother-of-pearl. The shape of the shells varies extremely according to locality, and the two genera are distinguished by the structure of the hinder end of the shell.

Fig. i. *Anodonta anatina* has a thin brittle shell, and the edge is straight, and not toothed.

Fig. k. *Unio pictorum* has a coarser shell, and ridge-like teeth on the edges. One of the commonest allied species is *Unio margaritifera*, which grows to a large size, and sometimes contains pearls.

II. Bivalves with the edges of the mantle partly connected, and with tube-like siphons.

Plate XXI. fig. a. *Tridacna gigas*, the Clam, is the largest shell known. The large ridged shell with undulating edges occasionally attains a length of four or five feet, and is sometimes placed in a church as a font. The impressions of the two large clasp-mussels are close together. The animal inhabits the Indian Ocean, and develops a byssus.

Plate XXII (left side).

The Cockles have a heart-shaped shell with strong marginal teeth. The animal project its foot, which is angulated, and ends in a point, through a crevice, and uses it for digging and leaping. In some places it is an important article of food. There are several closely allied species, and we have figured *Cardium costatum* (fig. b).

Fig. c. *Cyclas cornea* is a fresh-water mollusc which sometimes burrows and sometimes climbs among the water-plants. It has a convex horn-coloured shell and two clasp-mussels.

Fig. d. *Tellina virgata* has an oval shell rounded in front, and the hinder end is somewhat folded over.

Fig. e. *Venus verrucosa* belong to a large genus which is much admired for its elegant oval form and strong marginal teeth. The species figured inhabits the Mediterranean.

Fig. f. The Razor-Shell (*Solen vagina*) is open at both ends. The animals burrow one or two feet deep in the sand and mud, and are sometimes eaten, but are not much esteemed. They are either dug up with a spade, or drawn from their burrows with a slender rod.

Fig. g. The Piddock (*Pholas dactylus*) is a shell which is covered with sharp points and teeth which serve it as a rasp, by which it bores itself a hole in the rock. It is also a luminous animal.

Fig. h. The Ship-worm (*Teredo navalis*) has a small thick strong shell which covers only the front of the body. It has a worm-like shape and two additional calcareous plates. It bores into even the hardest timber, and has sometimes caused immense damage to piers and harbours, as well as to ships.

III. Molluscoidea.

Two groups of animals intermediate between the Mollusca and the Worms are included in this group.

They resemble each other in the course of their development, but have very little external similarity.

Class I. Brachiopoda.

The Lamp-shells are bivalves like the Lamelli-branchiata, but there is neither ligament, foot nor leaf-like gills. The shells are unequal in size, and in many species the convex lower shell has a perforated beak-like process, through which protrudes a stalk by which they fix themselves.

Plate XXII. fig. k. *Terebratula vitrea* has a calcareous shell, and at the base of the flattened dorsal shell rises a delicate veil-like calcareous structure, which serves as a support for the respiratory organs, which are called arms. At present

there are few living species of *Terebratula*, but they were very numerous at an earlier period of the world's history.

Plate XXII. fig. l. *Lingula anatina*, the Goose-Bill, represents the second section of the *Brachiopoda*. The tongue-shaped shells are thin and horn-like; there are no arms; and the animal makes burrows for itself at the bottom of the sea with a long fleshy stalk. The genus is met with in the oldest geological formations.

Class II. Bryozoa.

These are aquatic microscopic animals, which are always united to horny or calcareous supports, and were formerly classed with the corals. These frameworks are either arborescent or leaf-like, or form a crust over foreign substances, like the fresh-water

Plumatella, in which the tentacles of the separate animals are arranged in the form of a horse-shoe. In the marine forms they are arranged in a circle. *Eschara cervicornis* (fig. m) is an illustration of the calcareous skeleton of a marine species.

Subkingdom Vermes.

(Plate XXVIII.)

The Subkingdom of Worms is distinguished from that of *Articulata* by the want of jointed limbs. In the highest forms we indeed meet with stumps on the segments of the body which serve as organs of locomotion, but they are never divided into separate joints, like those of a crab, an insect, or a spider.

The outer integument is always soft, and unprotected by either an internal or an external skeleton. Only a few forms construct tubes to dwell in. In shape, they exhibit every transition from the long slender cylindrical thread-worm to the flattened tape-worm. In the higher forms the body is divided into separate

segments. There is a similar variety in the internal anatomy of the different divisions of worms, the lowest of which sink to a very degraded stage. Many worms pass a free life in damp ground, or in

salt or fresh water, but an equally large number are parasitic on other animals, among which are the best-known and most dangerous parasites of man.

Class I. Rotatoria.

We place the Wheel Animalculæ first, because they exhibit so many affinities to other Classes. They are almost microscopic organisms (the largest are $\frac{1}{50}$ of an inch in diameter) and are mostly inhabitants of fresh water. They have a ciliated apparatus on the upper part of the body which has the appearance of revolving wheels. The living animals are perfectly transparent, and are charming objects under the microscope, and very easy of observation. Some swim freely about, and others are sedentary in their habits.

Fig. a. *Rotifer vulgaris* has a crown of two ciliated wheels, and two eye-specks on the proboscis. At the back of the neck is a sucking-tube. The forked foot divides twice. The parts of the body indicated in the figures are as follows: 1) Eye-specks; 2) Wheels, exerted & retracted; 3) Sucking-tube; 4) Jaws, almost always employed in mastication; 5) Glands; 6) Stomach; 7) Termination of intestine; 8) Cells surrounding the stomach (liver-cells); 9 and 10) Eggs, one containing an embryo; 11) retractile foot.

Class II. Annelida.

These animals are the highest of the worms, and are characterised by their bodies being divided into a consecutive series of similar parts (rings or segments). They always possess blood-vessels and a nervous system, with organs of sense, but the development of special organs of respiration is only found in the most highly developed species; other-

wise they breathe, as is usual in the class of worms, with the whole surface of their bodies. A few of these animals are casual parasites, but most live free. According to their external appearance, they may be easily divided into two suborders, the Worms and the Leeches.

Order I. Chætopoda.

These worms are provided with bristles on the various segments of their body, which differ in shape and size, and are sometimes so abundant that they cover the animal with a thick downy clothing, and give some of the marine species a metallic lustre comparable to that of birds and insects, though most of the *Chætopoda* are dull and uniform enough in colour.

Section I. Polychætæ.

Worms provided with tentacles, cirrhi, and gills. The numerous bristles are situated on the rudiments of legs. They undergo metamorphoses.

Fig. b. *Aphrodite aculeata*, the Sea-mouse, is a common marine species thickly clothed with iridescent hair. Like most of its allies, it is a decidedly carnivorous animal.

Fig. c. *Polynoe impatiens* is a similarly iridescent species.

Fig. d. *Nereis margaritacea* is a slender species, capable of very rapid movement. It has several pairs of tentacles, and four eyes, as well as two strong pincerlike jaws, besides smaller teeth for tearing its prey.

The large number of allied marine forms are classified by the structure of the mouth-parts, and the form and number of their bristles. We have figured two more species of this division, *Æone lucida* (fig. e) and *Siphostoma diplochætos* (fig. f).

Fig. g. The Lug-worm (*Arenicola piscatorum*) varies a little in colour, and grows to the length of ten inches. Its body is divided into three sections, of which the middle one bears most appendages, and the hindmost none at all. The Lug-worm lives in the sand between tide-marks in the manner of

earthworms, and is very abundant in many places. It is much used by fishermen for bait.

With the Lug-worm we commence the section of *Chætopoda* which construct a tube-like dwelling, partly from materials which they find on the sea-bed, and partly derived from their own organisms. Another illustration is the following:

Fig. h. *Serpula contortuplicata* is a handsome species belonging to a large genus which covers any object which lies long in the sea with irregular tubing. They expand a beautiful crest of tentacles, but dart back into their tubes the instant they are alarmed. These tentacles represent the gills, and between them rises a calcareous lid which closes the tube. The mouth exhibits neither proboscis nor teeth.

Section II. Oligochætæ.

In these worms, tentacles, gills, mouth-armature and rudiments of legs are absent. The whole structure is inferior to that of the *Polychætæ*, and the bristles are small and scattered. The animals are hermaphrodite, and the eggs are laid in capsules, from which the young are developed without undergoing any metamorphosis.

Fig. i. *Lumbricus terrestris* is one of the earth-worms which live in mould, feed on the rotting substances which it contains, and reject what they cannot digest. Darwin has demonstrated their great importance in the economy of nature.

Fig. k. *Nais proboscidea* is a fresh-water worm with but few bristles. It is common in ditches and ponds, and is a transparent creature with a proboscis-like sucking-tube on the head, and two rows of hooked bristles on the belly, as well as a row of straight hairs on each side.

Order II. Hirudinei.

Fig. 1. *Hirudo medicinalis*, the Leech, is the best known representative of this Order. It has a flattened body with short rings but no distinct head, rudimentary legs, nor bristles. It is reared in large numbers in Southern and Eastern Europe for medicinal purposes, and its body is capable of great expansion when distended with blood. The sucking-

mouth is armed with 80 small movable teeth, arranged in a half-circle. The animals are hermaphrodite, and lay their eggs in capsules.

Fig. m. *Aulacostomum gulo*, the Horse-Leech, is common in ponds and ditches. It is sometimes very annoying to horses and cattle, especially in Southern Europe and North Africa.

Class III. Gephyrea.

This Class includes a few marine genera of comparatively slight importance, although zoologically interesting in some respects. They have all a retractile proboscis, an unjointed body, and a vascular system. The sexes are separate, and the young undergo metamorphoses. Fig. n. represents a dark green Mediterranean species, *Bonellia viridis*.

The proboscis is divided in front, and the expanded body bears two hooked bristles at the extremity. The female is here figured; the male is wormlike, and extremely minute, and lives in the female like a parasite. The genus *Sipunculus* (*S. Bernhardus* is represented at fig. o) may be recognised by the absence of the hooked bristles.

Class IV. Nemathelminthia.

These animals are interesting both from a Zoological and from a practical point of view. They may be recognised by their round thread-like or tube-like unsegmented bodies, which are destitute both of rudimentary legs and bristles. They have neither blood-vessels nor differentiated breathing-organs, but there is a nervous system, and sometimes organs of vision. They have special organs for offence and grasping, in the form of papillæ, teeth, hooks &c., at the front extremity of the body, which show them

to be parasites on other animals. Most of them are such, either permanently, or at different stages of their life. The sexes are separate, and the young undergo metamorphoses, for these worms pass different stages of their lives in different animals; and as it is necessary for them to pass from one animal to another in order to attain their full development, its course often becomes very difficult to trace. They are divided into two Orders according to the form of the body.

Order I. Nematoda.

The Thread-worms are characterised by their long cylindrical thread-like body. Some species are viviparous. Their development varies much. Some pass into an animal with the food, while others seek out their host themselves; and others again pass intervals of parasitism in alternation with a free life. Several species exhibit alternation of generations; i. e. the animal produces offspring wholly unlike the parents, while the latter in their turn reproduce the parent form, so that several generations are needful to complete a single life-cycle.

One of the most famous of these worms is *Trichina spiralis*. The male is $\frac{1}{16}$ of an inch in length, and the female twice that size; and they inhabit the intestines of various mammals. Thus, a female living freely in the intestines of a pig, produces from 1500 to 1800 living young, which immediately perforate the walls of the intestine, and fix themselves in the muscles, where they roll themselves together, gradually invest themselves with a calcareous covering, and may remain thus for years (as at fig. p). They require another animal for their further development, and if they do not obtain it, they gradually perish, but if they are introduced into another animal with the flesh (as into a man) the calcareous shell dissolves and the animals develop and produce young which again bore through the integuments to fix themselves in the muscles of their new host. The injury which they thus occasion causes the painful and dangerous disease called

Trichinosis, but if they once fix themselves in the muscles without causing the death of their host, they are no longer inconvenient or dangerous.

Fig. q. *Filaria medinensis*, the Guinea Worm, is a native of the tropics. The male is unknown, but the female, which grows to the length of several feet, inhabits the muscles of man. The parasite is extracted by opening the sore, and very carefully winding out the animal on a stick, for if it breaks, the millions of embryos in the body of the mother set up dangerous inflammation. Its life-history is not yet perfectly understood, but it is known that the young worms live in minute Crustacea (a species of *Cyclops*) and are probably swallowed with drinking-water.

Gordius aquaticus is a small thread-worm which lives parasitically in insects, but also lives freely in water. Its history too is obscure.

Oxyuris vermicularis is one of the commonest human parasites. The female attains a length of two-fifths of an inch, but the male does not grow to half that size. It is often found in the human intestines, especially in those of children. The eggs require no intermediary, but develop themselves at once into sexually mature animals, if they should again be introduced into the human body with food or drink. — Fig. r. *Ascaris lumbricoides* is another disagreeable parasite which is found in the small intestines of man. Here an intermediary is probably needful to its development. The female is estimated to produce fifty millions of eggs.

Some threadworms are found in plants, such as *Anguillula tritici*, a microscopic species which infests wheat. A nearly allied non-parasitic form is *Anguillula aceti*, the Vinegar Eel, which is found in

acid liquids, feeding on the small fungi which are there produced. It is just visible to the naked eye, but now that vinegar is more carefully manufactured, it is much less frequently observed than formerly.

Order II. Acanthocephali.

These are tube-like worms without mouth or intestine, but with a retractile proboscis bearing hooks, with which the fully-developed animals attach themselves to the wall of the intestine in vertebrate animals. The asexual larval form encysts itself in small in-

vertebrate animals, and develops itself if its host is eaten by a higher animal. They very rarely infest man; one species, *Echinorhynchus gigas* (fig. s) is found in the pig, and its embryo form in the grub of the Cockchafer.

Class V. Plathelminthia.

This is a large division, including the lowest worms, and derives its name from the flattened form of the unsegmented body. Only the higher species possess blood-vessels and respiratory organs, and the digestive system is not only able to dispense with

an excretory duct, but may be altogether absent. Most species are hermaphrodite, and they undergo a complicated series of metamorphoses, often combined with alternation of generations. Some are parasites, but many live in mud and under stones in the water.

Order I. Turbellaria.

These are worms of an oval or ribbon-like form, with the surface of the body uniformly clothed with minute cilia. They are not parasitic, and have no grasping or sucking organs. Their development is frequently direct.

The *Nemertina* occupy the highest place, from their large size, more complicated structure, and the separation of their sexes. Only one small form is found in fresh water. Most of the species are marine, and often finely coloured. They are distinguished by possessing an extensile proboscis, which is armed in many species with a dagger-like weapon, used to impale other and smaller organisms. Portions of their body are easily lost, but they are extremely

tenacious of life, and are gifted with great powers of reproduction.

The *Planariæ* are of smaller size, and usually of oval form; many species inhabit fresh water; among which is *Planaria alba* (fig. t). This and other species (generally black or brown) are found about stones and rushes in brooks, ponds and marshes. In spring they deposit small round or oval capsules of the size of a pin's head, and often stalked, containing 4 or 5 delicate eggs. Among the marine species, the eggs are often laid in strings. As may be seen in the transparent *Planariæ*, the intestine is branching, a character common to all the *Turbellaria*.

Order II. Trematoda.

These animals differ from the last in their parasitic habits. They have no body-cavity, but the organs are embedded in a matrix of uniform consistence. They possess organs of suction, the number of which serves to characterise the different groups.

Fig. u. *Fasciola hepatica*, the Liver Fluke, is one of the commonest and most dangerous parasites. It lives in the gall-ducts of the sheep, sucks the juices of the liver, and frequently destroys large

numbers of the animals. It passes its early stages in fresh-water snails, and therefore chiefly infests sheep which feed in swampy situations.

On the other hand, all the *Trematoda* with more than two suckers have a direct development, without metamorphoses.

Fig. v. *Tristomum coccineum* represents a genus of parasites which infest the skin and gills of fishes.

Order III. Cestoda.

The tapeworms close the series of worms, and hideous as they are, their life-history is of much interest and importance. The fully-developed sexual animal has neither intestines, respiratory organs, nor organs of sense. It has a ribbon-like form, and consists of a number of joints (proglottides) increasing in thickness and breadth hindwards. It fixes itself with its head to the wall of the intestine of some vertebrate animal, and the whole chain hangs loose in the intestine. Every separate joint is furnished with sexual organs, and the last, which is always the most developed, becomes filled with eggs, drops off, and is discharged in the natural way. The minute embryos, which require another animal for

their development, fix themselves everywhere, and if swallowed, make their way into the blood-vessels, and are thus carried into the liver, lungs, muscles, brain &c., where they assume a bladder-like form containing fluid (*Cysticercus*). As in the *Trichina* these sexless forms gradually perish, unless the flesh in which they are embedded is eaten, when they assume the form of a tapeworm in the intestines of their new host. It follows from this that the two forms must inhabit animals which have a certain relationship to each other. Thus the *Cysticercus* of the tapeworm of the cat is found in the mouse. Although the tapeworm causes debility rather than actual disease, the presence of *Cysticerci* in large

numbers in certain organs may cause the death of the animal which they infest.

Of the two tapeworms which infest man, *Tænia solium* (fig. w) has, in addition to four suckers, a circle of hooks in the middle of the head, which is wanting in the second species, *T. saginata* (fig. x). The latter may grow to the length of four yards, and is larger, stronger and more active than *T. solium*, which only attains the length of 6 or 8 feet; and its sexual organs are more ramified. The *Cysticercus* of *T. solium* (fig. y) lives in the pig, and that of *T. saginata* in the ox. But a far more dangerous animal is a small tapeworm which lives in the dog. If by any chance one of the eggs should enter the body of a man, the embryo wanders into various organs, usually the liver, where it grows to a *Cysti-*

cercus which is sometimes as large as a child's head, and frequently causes death. The disease known as the Staggers in sheep is caused by *Cænurus cerebralis*, (fig. z) which infests the brain; and the corresponding tapeworm lives in the dog.

Fig. zz. *Bothriocephalus latus* differs from the species of *Tænia* by its flattened head, with two suckers, and by the sexual organs opening on the surface of the joints. It is generally found in regions where water and fish are abundant; for its embryo form is found in the pike and probably in other fish. The sexual animal grows to the length of 24 feet in the human intestines, where it may remain for 20 years; but it is more easily got rid of than the species of *Tænia*.

Subkingdom Echinodermata.

(Plate XXIX.)

The animals of this Subkingdom are principally marine, and are usually characterised by the possession of spines; and the integument which covers the internal organs contains calcareous particles which are frequently large and numerous enough to form a strong external skeleton. The internal structure is likewise remarkable, for the separate organs are arranged in fives. In addition to the nervous, digestive, and circulatory systems they possess a peculiar structure called the ambulacral system, which communicates with the surrounding sea-water. It consists of a ring of water-holding canals round the

mouth, and offshoots penetrate through the pores and openings of the skin and the hard outer integument, and appear in the form of sucker-feet, which effect the progression of the whole animal by successive adhesion.

In most species, the sexes are separate, and eggs are laid; a few are viviparous. They all creep on the ground or over sea-weed, and only swim freely in their earliest stages. They are known, according to their forms, as sea-urchins, starfish and sea-cucumbers.

I. Echinoidea.

- a) *Regularia*.
- b) *Clypeastridea*.
- c) *Spatangidea*.

II. Asteroidea.

- a) *Asteriidae*.
- b) *Ophiuridae*.

III. Crinoidea.

IV. Holothuroidea.

- a) *Pedata*.
- b) *Apoda*.
- c) *Elasipoda*.

Order I. Echinoidea.

In the Sea-Urchins, the body is enclosed in a firm immovable calcareous external skeleton, called the Shell. The openings for the sucker-feet are called ambulacræ and are arranged in rows, and are limited to certain plates of the skeleton. All the plates are furnished with round regularly-arranged elevations, on which are placed movable spines, beyond which, however, the sucker-feet always extend. The Sea-urchins are round or heart-shaped. They possess a curious calcareous masticatory apparatus.

Fig. a. *Echinus sphaera*, the Common Sea-Urchin, belongs to the family *Regularia*. The mouth and vent are placed opposite to each other, and the ambulacræ run from one pole to the other. The spines are rather short, slender, and of a bluish colour. This species is eaten on the shores of the Mediterranean.

Fig. b. *Acrocladia mamillata* belongs to the same order, but differs in the large size of its variegated spines; it is a native of the Pacific.

The *Clypeastridae* are shield-shaped, and so much flattened that the shell scarcely looks large enough to contain the organs of the body. The mouth is not placed opposite to the vent, and the ambulacræ do not run from one pole to another, but form a five-leaved rosette. The spines are very small.

Fig. c. *Scutella hexapora* is remarkable for the shell being indented with 6 incisions.

The *Spatangidea*, or Heart-Urchins, have no masticatory apparatus. The body is heart-shaped, and the mouth and vent are placed near together, often on the lower surface.

Order II. Asteroidea.

In the Starfishes, the rows of sucker-feet are limited to the ventral surface. The dorsal surface is leathery, and beset with warts and spines. It likewise contains calcareous plates, though these do not form a skeleton, as in the Sea-Urchins. There are larger plates where the dorsal and ventral surface unite, which are often set with long spines. The shape of the body is always flat.

In the typical *Asteriidae* the body passes gradually into the arms, without there being any fixed boundary between them. This is likewise the case internally, for the intestines and sexual organs send offshoots into the cavities of the five arms.

Fig. d. *Asterias aurantiaca* may serve to illustrate this family. These Starfishes feed on mollusca,

and are disliked by fishermen, as they often destroy their bait. If they lose an a. n., they have the power of reproducing it.

The *Ophiuridae* possess a flattened body from which the arms are sharply separated; the internal organs are limited to the body, and do not pass into the arms.

Fig. e. *Ophiura lacertosa* is a very active creature, and can force itself through the smallest crevice. Two of each of the chalky plates at the base of the arms are naked on the dorsal surface, and the others are covered with fine spines.

Fig. f. *Gorgonocephalus arborescens* is a starfish in which the arms continually subdivide into finer branches.

Order III. Crinoidea.

This Order, though important in former epochs of the world's history, is now limited to a few genera and species. The body of the animal, which is called the calyx, is surrounded by ten jointed and often branching arms. There are fine rami on the separate joints, which give them the appearance of feathers. The calyx is usually fixed on a long stalk, consisting of a large number of movable pentagonal calcareous sections, which bear whorls of cirri at regular intervals.

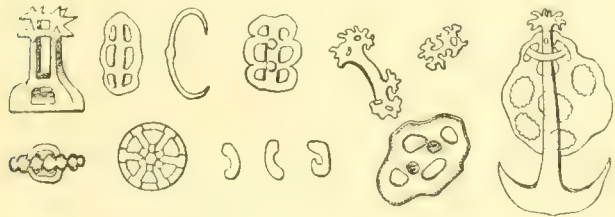
Fig. g. *Pentacrinus caput Medusæ* is found in

the West Indies, and was formerly supposed to be the only living representative of the group, and was one of the rarest and costliest ornaments of museums. The animals are fixed on the sea-bed by the long stalk, on which the body sways, surrounded with its delicate arms. Other species are now known, which live at an immense depth in the sea.

In the genus *Comatula*, which inhabits the European seas, the animal is only fixed on a stalk when young, and afterwards swims freely about.

Order IV. Holothuroidea.

The Sea-Cucumbers have a leathery skin, without spines, but only with microscopic calcareous particles, the form of which is characteristic of the various genera and species. A few types of the strange forms which the spicules assume are here figured.



The sea-cucumbers live on the bed of the sea, where they absorb the mud, and nourish themselves with the organic matters contained in it. The form is long, and the mouth is placed at one end, surrounded by a cluster of tentacles; the vent is placed at the opposite end of the body. Some species are dried and eaten by the Chinese under the name of Trepang.

Family I. Pedata.

These species have sucker-feet like the star-

fishes and sea-urchins, a more or less cylindrical form and a branching respiratory apparatus.

Fig. h. *Holothuria tubulosa* is a common species in the European seas, and grows to the length of a foot. The sucker-feet on the ventral surface are flat at the ends, and those on the dorsal surface conical. Numerous calcareous particles are embedded in the skin.

Family II. Apoda.

These animals have neither lungs nor sucker-feet. They are of small diameter, but wormlike, and many species grow to the length of several feet. To this group belongs the genus *Synapta*, which may be recognised by the calcareous particles being anchor-shaped.

Family III. Elaspoda.

This section lives exclusively at great depths, and has only recently been discovered. The belly is flat, and the sucker-feet are arranged in rows. The back is usually furnished with appendages of considerable length. The animals are of large size; but lungs are absent.

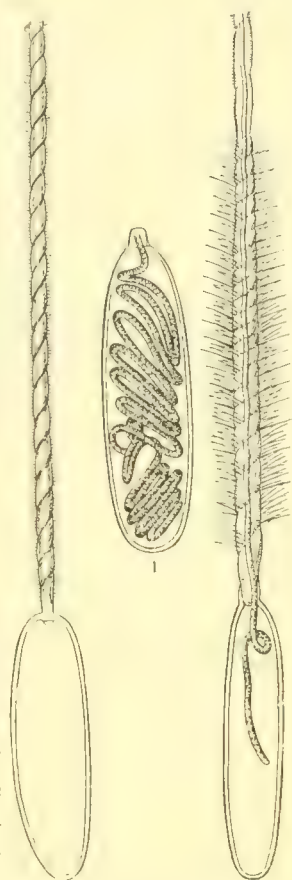
Fig. i. *Næra lucifuga* is found at a depth of two thousand fathoms in the Atlantic Ocean.

Subkingdom Coelenterata.

Many of these animals resemble plants in the beauty of their colouring, and in their being fixed to one spot. Their organisation is usually very simple, consisting mainly of a cavity which supplies the place of a circulatory and digestive system.

When the sexual organs are mature, they generally appear first in the form of simple groups of cells, and not always in the same place. Many develop a chalky or horny skeleton, and others remain soft. In many species the substance of the body resembles jelly,

and is extremely impervious to water. — Many species form stems of a more or less constant form by budding and branching, which are fixed to the ground or to rocks. Others form single individuals, and are then in most cases capable of free motion. In addition to increase by budding, we meet with sexual reproduction, in which the egg develops a microscopic larva, which swims freely about with the aid of cilia, and takes some time to develop into the mature animal. Alternation of generations is often met with, which combines the formation of stems with the alternation of sexual and asexual reproduction. This makes the life-history of many *Coelenterata* very complicated. Sponges are used in our household economy; but of far greater importance in Nature are some of the corals, which build up whole mountains and islands.



Urticating Capsule.

1) Thread rolled up; 2) ditto, half unfolded; 3) ditto, fully unrolled.
(Highly magnified.)

The *Coelenterata* are divided into four classes, the first three of which are remarkable for the possession of urticating organs. These are microscopic weapons consisting of an oval capsule filled with fluid, containing a hollow spiral thread. The least touch bursts the capsule; when the thread darts out, unwinds, and fixes itself with the hairs and bristles which invest it, in the skin of the victim. The venom with which it is armed causes violent inflammation, powerful enough to cripple small animals, and the more they struggle, the more poisoned arrows pierce them. The number of these microscopic weapons is enormous, for a single tentacle of *Anthea cereus* has been estimated to contain 43 millions.

All these animals are marine, with a few unimportant exceptions; and they are divided as follows:

Class I. Ctenophora.

Class II. Polypomedusæ.

Order I. *Acalepha.*

II. *Siphonophora.*

III. *Hydroïda.*

Class III. Anthozoa.

Order I. *Octactinia.*

II. *Hexactinia.*

Suborder I. *Actinaria.*

II. *Madreporaria.*

Class IV. Porifera.

Order I. *Ceraospongia.*

II. *Halichondria.*

III. *Calcispongia.*

Class I. Ctenophora.

Freely-swimming animals of jelly-like consistence. The mouth, which is often surrounded by lobes and tentacles, leads to a body-cavity. There are 8 zones of plates, bearing cilia, which run from one pole of the body to the other, on the upper surface, and the animal moves by the combined action of the cilia, and by the contraction of its body. The animals are hermaphrodite, and there is

no alternation of generations. They feed on other marine animals. — Three species are represented on Plate XXIX; Fig. k. *Beroë ovata*; fig. l. *Cestum Veneris*, a ribbon-shaped transparent creature, which shines in the sun with the most beautiful colours when swimming in the sea; and fig. m. *Cydroppe pileus*, a rounded species, with two long retractile filaments which it uses to catch its prey.

Class II. Polypomedusæ.

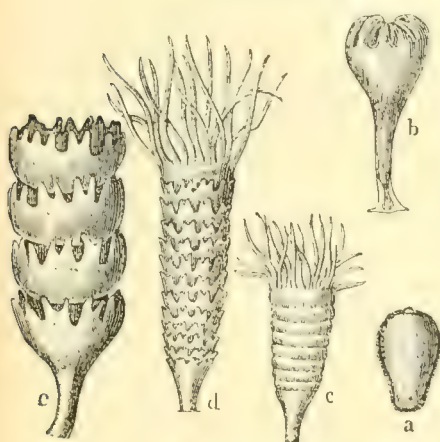
Here we meet with an assemblage of creatures which do not seem to have the slightest resemblance between them, such as the jelly-fish and the sea-anemones. And yet these forms are so closely allied that it can only be supposed, that one has originated from the other. Here, too, we meet with alternation of generations. The Medusæ, or Jelly-fish, are sexually-mature animals, but their eggs do not produce jelly-fish. The young animal fixes itself firmly, and grows to a branching tree, which is called a polyp or polypidum. Young Medusæ are produced on the branches of this tree, which detach

themselves, swim about, frequently grow much larger, and again reproduce themselves sexually. This is the rule, though we meet with exceptions in some subdivisions. Among the lowest forms, the Medusæ do not detach themselves from the polypidum, but produce eggs, so that they sink from the level of independent beings to that of mere organs. In the higher forms, the reverse is the case. Here the Medusa-stage is greatly developed, and the polyp-stage much reduced, for the polypidum does not branch, while the Medusæ are detached by constriction.

Order I. Acalepha.

The Jelly-fish are the typical *Medusæ*, and are umbrella-like in form, the margin being usually set with threads. From the middle hangs a stalk which

Development of *Medusa aurita*.



- a) First Stage. Freely swimming larva. (*Planula*-Stage.)
 b) Second Stage. Fixed Polyp (*Hydratuba*-Stage.)
 c) & d) Third & Fourth Stages. The polyp develops tentacles and circular constrictions. (*Scyphistoma*-Stage.)
 e) Fifth Stage (*Strobila*-Stage). The tentacles disappear and the constrictions throw off young freely swimming *Medusæ*.

surrounds the mouth. They are rather large animals and exhibit a beautiful play of colours. They are extremely difficult to preserve or examine, except in the sea itself, on account of the large quantity of

water contained in their jelly-like substance. When removed from the water, they rapidly dissolve, leaving scarcely a trace behind.

Plate XXIX. fig. n. *Medusa aurita* is one of the commonest species. It is a gregarious animal, and the pale blue umbrellas oscillate at times by hundreds on the waves, or are driven in shoals into bays and harbours. The young do not form a polypidom, but a single stem, from which the *Medusæ* detach themselves. The separate stages of the *Medusæ* were formerly regarded as distinct animals, and described as such.

Fig. o. *Pelagia panopyra* is distinguished by its beautiful red colour, the length of its 8 marginal filaments, and its 4 slender oral tentacles.

Fig. p. *Cephea papuensis* is remarkable for having each of the tentacles divided, so that the mouth is surrounded by 8 club-shaped appendages.

Fig. q. *Rhizostoma Aldrovandi* represents a section of the *Medusæ* in which there is no mouth, but the 8 tentacles exhibit apertures for the reception of microscopic nourishment. The rythmical motion of the umbrella is very conspicuous; and the urticating properties of this species render it very annoying to bathers.

Order II. Siphonophora.

These organisms are remarkable as occupying an intermediate position between a compound animal and an individual. In other compound animals (corals for example) the individuals resemble each other in appearance and in organisation, but in the *Siphonophora* the separate animals of the colony perform different functions, and likewise change their appearance, thus sinking to the level of mere organs. The *Siphonophora* are swimming compound animals, generally with a longitudinal axis, provided with a bladdery expansion above, to keep the stem upright. On the sides are placed the individual animals, with their body-cavities communicating with the cavity in the longitudinal axis. Some of the animals are bell-shaped, and assist in swimming, others are feeding animals, which possess a long thread set with urticating organs; and others again are medusa-like animals, which secrete the sexual products, and can detach themselves. The entire stem differs much in appearance according to the form, number and arrangement of the separate polypi.

Plate XXIX. fig. r. In *Veella scraphidea* the longitudinal axis is compressed to a flattened disc, on the under surface of which the separate polypi live.

Fig. s. *Diphyes gracilis* is an elegant species with two large swimming-bells. Beneath them, at equal distances, hang the feeding polyps, with their long filaments, and the umbrella-shaped sexual polypi.

Fig. t. *Physalia arctusa*, the Portuguese Man-of-War, is one of the handsomest of the swimming polypi. The entire axis of the animal is expanded into a bulky horizontal bladder. The feeding polypi, which are situated on the bladder, have very long and strong filaments, covered with millions of urticating organs, which render the creature a very formidable antagonist.

Plate XXX. fig. a. *Physophora disticha* is furnished with a row of bell-shaped swimming polypi on each side, in addition to the bladder at the end of the longitudinal axis.

Order III. Hydroida.

In this Order the polyp-state predominates. The *Medusæ* which are produced from the eggs, either do not detach themselves at all from the polypidom, or if they do so, remain quite small. The stems are usually branched.

Plate XXX. fig. b. *Corymorpha nutans* has an unbranched stem, attached by root-like processes. The small free *Medusæ* are bell-shaped, and provided with a long marginal thread. Our figure shows how they are placed in a circle round the mouth of the polyp, before they detach themselves.

Fig. c. *Bourgainvillia ramosa* is a very delicate tree-like species. The *Medusæ* are placed like little buttons at the end of the twigs, from which

they detach themselves, although in some very closely allied species they remain fixed.

Fig. d. *Hydra viridis*, the Fresh-water Polype, is a representative of almost the only fresh-water genus of the *Cœlenterata*. The few species of *Hydra* are generally fixed to floating objects, or to snail-shells. If a handful of duckweed is placed in a large glass, the little animals will soon be seen on the roots expanding a circle of tentacles. *Hydra* is famous for its tenacity of life, for it may be cut to pieces, and each fragment will become a new animal; or it may be turned inside-out like a glove without suffering any injury. It has no medusa-form, but reproduces itself by fission or eggs.

Class III. Anthozoa.

The Corals have always been among the most famous productions of the sea, but it was long before it was known that the costly and beautiful red coral, as well as the numerous white corals which form great reefs in the tropical seas, were animal productions, and closely allied to the low forms of life, without a skeleton, called Sea Anemones. Both consist of a hollow cavity, but in the corals, this is divided into a number of vertical partitions by numerous walls of separation.

The mouth, or opening to the body-cavity, is surrounded by tentacles, equal in number to the partition-walls; and these tentacles are well provided with urticating organs.

Most of the coral animals form colonies of various forms by budding. Channels penetrating the mass in which the separate animals are embedded, unite all the animals of the colony, so that the nourishment taken by one animal feeds the common

stock. The animals are called polyps, but the colony produced by the budding and branching of the animals, and on which they are fixed, is called the Polypidom or Polyparium. It rarely remains soft, but usually forms a skeleton of vary various form, which may be so massive as to form a firm rocky core, with only a thin layer of animal matter on the surface, or scattered through it. When the animals die, this substance, which is usually of a shining white colour, retains the exact form of the colony. In other cases the polyparium is horny, or contains but few calcareous layers. The coral-animals which form no colonies, are usually quite fleshy, and without skeleton. The coral-animals multiply by eggs as well as by budding. From the eggs a freely-swimming larva is produced, which does not fix itself for some time. All the corals are marine, and they are classified by the number of tentacles.

Order I. Octactinia.

These have 8 ciliated tentacles, and as many partition layers. The animals found colonies, which usually contain an axial skeleton of horny or calcareous matter. The skeleton is often limited to a slight calcareous deposit in the integument of the colony.

Plate XXX. fig. e. *Alcyonium palmatum*, the Dead Man's Fingers, forms fixed colonies with no axial skeleton, of leathery consistence, and with slight calcareous deposits of a determinate form.

Fig. f. *Pennatula phosphorea*, the Sea-Pen, has a horny yielding axial skeleton, with the lower end fixed in the sand or mud at the sea-bottom. The colony has the shape of a feather, and the separate animals are placed on its side-branches. It is a luminous animal.

Fig. g. *Umbellula encrinus* is a species found at a great depth in the Northern Seas. It has a long stem, at the upper end of which the animals are arranged in such a manner that the whole has somewhat of the appearance of a magnificent dandelion, swaying on a slender stalk.

Fig. h. *Renilla violacea* is a small and inconspicuous colony in comparison to the last, but the contrast between the blue kidney-shaped stem and the yellow animals planted on it give it a pretty appearance.

Fig. i. *Gorgonia flabellum* is called from its shape Venus's Fan. We have figured only the

skeleton, and not the animals. It comes from the West Indies. In this and the allied species, the horny or calcareous tree-like or fan-like skeleton is covered with a thin crust which is easily rubbed off.

Fig. k. *Corallum rubrum*. The Red Coral has always been highly esteemed. The colonies form large branching stems with a red axis as hard as stone, which is covered with a red porous layer, easily removed, containing isolated calcareous particles. The separate animals are all connected by the pores, and have the appearance of shining white stars on the red stem; but as soon as they are touched, they withdraw their tentacles, and disappear. The young animals are small wormlike ciliated creatures, which swim freely about for a time. The Red Coral is found only in the Mediterranean Sea. The coral fishery, in which 300 vessels are annually engaged, and which yields a clear profit of upwards of £100,000, is carried on chiefly on the coasts of Algeria and Tunis. The corals, which live at the depth of from fifteen to eighty fathoms, are torn away and brought to the surface by specially constructed nets. The price of the raw material varies from ten shillings to £10 per pound according to the size and colour.

Fig. l. *Tubipora purpurca* is found in the Red Sea, and has also a very solid red skeleton. Here, however, the separate individuals are arranged in parallel tubes connected by horizontal plates, so that the whole is not unlike the pipes of an organ.

Order II. Hexactinia.

In these animals, the tentacles are either six in number, or a multiple of six; and in the latter case they are arranged in a series of separate rows. They are divided into two sharply defined Suborders.

Suborder I. Actinaria.

In the Sea-Anemones there is no calcareous skeleton. They are generally separate animals of considerable size and bright colours, and can creep slowly from place to place by means of a retractile foot. They are richly provided with urticating cap-

sules, and feed on small fish, crustacea, &c. In captivity they are fed with fragments of meat. The numerous tentacles which surround the mouth are reproduced if cut off, and if an animal is cut in two, two new ones are formed.

Plate XXX. fig. m. *Sagartia rosea* has bright red tentacles spotted with white.

Fig. n. *Anthea cereus*, the Opelet, is remarkable for its beautiful green colour, and numerous tentacles (about 180), which are estimated to be armed with from 6,000 to 7,000 millions of urticating capsules.

Fig. o. *Actinia mesembryanthemum*, the Beadlet, is by far the commonest of the sea-anemones on our coasts. It varies much in colour, but may always be known by the row of blue beads at the base of the tentacles, from which it derives its name.

Suborder II. Madreporaria.

The Madrepores possess a calcareous skeleton, which exactly reproduces the form of the animal, even in the species which live singly, for it is not only the outer wall which is solid, but as many vertical calcareous partitions project from the cup towards the middle, as there exist mesenterial folds and tentacles.

Most madrepores form colonies, and they are very numerous in the tropical seas, where they form reefs and barriers at a moderate depth, which resemble the most beautiful submarine gardens.

In the Pacific Ocean, the coral reefs are most dangerous to ships; and they likewise form the foundation of innumerable islands, where the Coconut and bread-fruit tree establish themselves long before they are followed by man. Three kinds of coral-formations are distinguished. The *fringing reefs* skirt the edge of the land. There is often a more or less broad channel between the land and the reef; and this formation is called a *barrier-reef*. The reef lies opposite the shore, and forms a strong barrier against the waves; and the water in the lagoon generally offers a safe anchorage. These barrier-

reefs are often of great extent; and that which fringes the coast of North Australia extends for a distance of 1250 miles. The third class of coral formation is the *Coral Island*, or *Atoll*. These are more or less broad coral-reefs which surround a sheet of water. There are channels through the reef, and in the middle of the ring there is often a mountain rising from the bottom of the sea. As soon as the summit of the reef reaches the surface, it collects a layer of soil on which seeds take root. These Atolls are generally found in clusters. Of course they must be founded where reef-corals rise from the bed of the sea to within a short distance of the surface. This process has been going on for ages, and many lands owe their foundation to the labours of the coral animals, often popularly, but incorrectly termed coral-insects.

The skeletons of three reef-corals are figured on Plate XXX.

Fig. p. *Madrepora verrucosa* forms a tree-like colony.

Fig. q. *Fungia scutaria* illustrates the mushroom corals, which form no colonies of large extent (the figure represents a single individual. The calyx is longitudinally contracted, and there is a cleft leading to the body-cavity of the animal.

Fig. r. *Echinopora gemmacea* is one of the stony corals. Each star forms the dwelling of a separate animal, and by the complete petrification of the central foundations, arises a massive colony in which the separate calyces are embedded.

Class IV. Porifera.

The Sponges differ from the higher *Cœlenterata* | do not form colonies are cylindrical hollow animals

in the want of urticating organs, and the whole Class stands at a very low level. No Sponge possesses the power of voluntary motion, and most of them form colonies in which the individuals are all connected by channels. Deposits of horny, calcareous, or siliceous matter* form a firm groundwork, overlaid by the animal substance. Many species are met with, encrusting stones and shells on the bed of the sea, or are found in clusters adhering to rocks, like the sponges used for washing purposes. Others again form tree-like colonies; but there is no spontaneous motion of tentacles to reveal their animal nature to the naked eye. The sponges which



Spicules of Sponges. Those marked * are calcareous, and all the others siliceous.

with no subdivision of the body-cavity. The sea water which enters through numerous microscopic openings in the framework of the animal, always contains microscopic organisms which serve for food. A large opening at the extremity of the longitudinal axis of the sponge serves to discharge the superfluous water; and the movement of the water in the required direction is due to cilia, with which the cells of the body of the sponge are covered. The openings by which the separate animals discharge water look like large craters on the colony of the sponge.

Sponges may be divided according to the structure of the skeleton, without

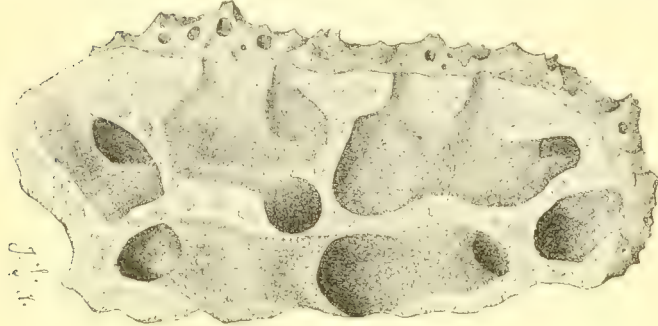
the distinction being made too stringent, into horny, siliceous, and calcareous sponges. The toilet-sponges belong to the first class. The horny filaments are arranged in layers, and form a more or less dense network. In the calcareous and siliceous sponges spicules of lime or flint are embedded in the animal substance. These are often of a pure white, and of elegant forms, resembling needles, hooks, anchors, spiny balls, spades, walking-sticks, and many other figures, alternating with cross-bars, in the middle

of which rises a small tree, with long clustered needles.

These spiculæ are sometimes scattered through the animal substance, and they are sometimes united into a firm skeleton which forms a faithful outline of the sponge, after the animal life has departed. The sponges are almost exclusively marine, and sometimes produce eggs, which develop a larva which swims freely for a short time, and sometimes increase by budding.

Order I. Ceraospongia. (Horny Sponges).

The Toilet-Sponge (*Spongia usitatissima*) is



Section of a horny sponge, typical of this Order. Its skeleton consists ex-

clusively of elastic horny filaments, which form a network, which sucks up water into its many empty channels. Sponges are used for different purposes according to the firmness of their tissues. The sponge-fishery is carried on chiefly on the coasts of Dalmatia and Turkey, partly by divers, and partly by uprooting the sponges with tridents, from a boat. The sponges are first kneaded till all the slimy animal substance which overlays and pervades them, is removed, when they are washed clean with water. The sand which they usually contain afterwards is only a fraudulent addition to increase the weight. Latterly attempts have been successfully made to propagate sponge by artificial division.

Order II. Halichondria. (Siliceous Sponges).

In these, we find siliceous deposits of various forms, often intermixed with horny substance.

Plate XXX. fig. s. *Axinella polypoides* is one of the few forms which possess a fixed axis resembling that of a colony of polyps. The number of separate individuals of which the colony consists is indicated in the figure.

To the siliceous sponges belongs the Fresh-water Sponge (*Spongilla fluviatilis*) which consists of a greyish-brown crust over old woodwork, &c., in water, which is easily rubbed off. Its spicules under

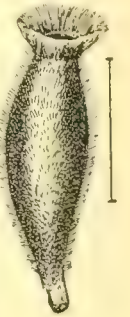
the microscope form fine slender spindles, sticking together, and forming a delicate network.

Fig. t. *Euplectella aspergillum*, Venus's Flower-Basket, is one of the most beautiful of the Vitreous Sponges, in which the siliceous deposits form a firm skeleton. When the animal substance is removed, the skeleton forms a long tube of the purest white, about nine inches long, and latticed in at the top as well as at the sides. The lower end of the tube is fixed in the sand, and is surrounded by a long tuft of fine needles, which look like spun glass. It is a native of Japan.

Order III. Calcispongia. (Calcareous Sponges).

Here the skeleton consists entirely of calcareous spicules, which are either simple, or 3- or 4-armed. All the forms occur in the same species.

Many calcareous sponges are single, as is *Scandra ciliata*, here figured.



Subkingdom Protozoa.

The *Protozoa* occupy the lowest place in the Animal Kingdom, as the *Vertebrata* occupy the highest. As we descend the scale we meet with simpler and simpler organisms. We find organs which form an independent system in the bigger animals, such as the circulatory system, growing gradually simpler and less-distinct, till they unite at last with a wholly different system, as in the body-cavity of the *Cœlenterata*, which serves both for digestion and circulation. Complication of organisation corresponds to complicated conditions of life. In the higher animals, the function of reproduction is confined to the sexual

organs; but in the lower animals a new animal may arise from any part of the body by budding or fission. Among the lower animals sexual reproduction alternates irregularly with asexual, causing the naturalist much perplexity in following out the life-history of the animal. In the lowest animals sexual reproduction disappears altogether, and the *Protozoa* multiply by subdivision. But the chief feature in which they differ from other animals is in the simplicity of their structure. We seek in vain for any trace of separate organs, such as nerves, muscles, skin, &c. In all other animals, even in the

sponges, the microscope reveals certain elements called cells, which serve as a foundation for the structure; but we do not find even this in the Protozoa. They are merely independent and freely-moving cells, and consist of protoplasm, a slimy jelly-like substance, which is recognised as organic, and which also exists in the cells of the highest animals. But there is no structure in the protoplasm of the Protozoa, and it concentrates in itself all the functions which are assigned to separate organs or systems of organs in the higher animals. The simplicity of the Protozoa is sometimes varied by the relationship which the organic mass exhibits towards inorganic matter. We have already seen in other groups of animals, such as the Holothuriæ, the corals, and sponges, how inorganic matter such as lime or siliceous matter enters largely into the structure of the body in many animals; and this occurs likewise in

the Protozoa. Many species possess a calcareous or siliceous skeleton of determinate form. Thus arises a wonderful richness of genera and species among the Protozoa, which all exhibit the same protoplasmic structure to our perceptions, though their varied and delicate skeletons are the microscopist's delight. The Protozoa are likewise of great geological importance, for their microscopic shells, heaped together in untold millions, formed vast masses of rock in former ages, which have since been upheaved, forming a thick layer which covers thousands of square miles in many parts of the world. The Infusoria are numerous both in fresh water and in the sea, and their germs are found everywhere. Many species may be dried up, and revived under more favourable conditions, and are thus able to withstand all normal variations of heat and moisture.

Class I. Infusoria.

Plate XXII. (right side).

It was formerly supposed that these microscopic organisms were produced by steeping dry substances in fluids, but we now know that the germs are carried about by any puff of wind, and can thus reach any fluid, however well preserved, and revive. The Infusoria are the highest Protozoa, for their protoplasmic body is enclosed in a thin integument of determinate form, and is often provided with cilia in certain situations. The protoplasm contains darker spots or nuclei, as well as a clear bladder which contracts at regular intervals.

Reproduction takes place as follows: Two individuals fuse themselves together, and the new animal grows to a certain size, and then divides in two, and these continue to subdivide until they have reached the size at which they combine with another individual. The Infusoria feed on smaller examples of their own Order, or on the microscopic larvæ of higher animals; or live as parasites in the intestines or other organs of various animals.

Fig. q. *Opercularia nutans* and fig. r. *Vorticella microstoma* are among the prettiest fresh-water species, and are common in streams and ponds. Both rest on stalks, and the mouth, at the end of the pitcher-shaped animal, is surrounded by a ring of constantly

vibrating cilia. (The names of the plate should be corrected as above). The Bell-Animalculæ are constantly oscillating backwards and forwards, and at the least touch the stalk of *Vorticella* rolls itself instantaneously into a spiral.

Fig. s. *Stylonichia mytilus* is a freely swimming Infusorium provided with a number of shorter or longer bristles. When a drop of water in which Algæ grow is placed under the microscope, this animal will generally be seen in constant movement, sometimes darting straight onwards, and sometimes revolving on its own axis between the fronds of the Algæ.

Fig. t. *Noctiluca miliaris* is a marine form. It is found gregariously in many places, and when the conditions are favourable it rises to the surface in such multitudes that the sea becomes slimy, and emits a reddish light over a wide area. After sunset, and especially in the early morning hours, the whole surface shines with a magical bluish light. The luminosity of the sea is due in great part to the presence of this little infusorium, though other and larger luminous animals are also present. This is, however, a phenomenon which is only seen at its best at uncertain intervals.

Class II. Rhizopoda.

These are animals without determinate form, and destitute of cilia. The skinless protoplasm throws out and retracts processes from any part of the body indifferently. Thus the animal changes its shape continually, and these processes, or pseudopodia, serve both to effect the movements of the animal, and to

take food, as they surround and absorb any organic substances, such as Algæ. Although the protoplasmic body itself is of no determinate shape, yet it is frequently accompanied by calcareous or siliceous skeletons of various fixed shapes.

Order I. Radiolaria.

The *Radiolaria* always possess a siliceous skeleton, consisting either of variously-formed needles which unite in the midst of the protoplasmic mass,

from which they radiate in different directions; or of a connected skeleton variable in form, with numerous openings through which the central protoplasmic body,

which is often coloured, throws out its threadlike processes. The skeletons are of very delicate and varied forms, resembling helmets, bishop's mitres, baskets, or bundles of arrows. Every conceivable shape is found among the *Radiolaria*, and they form a charming study.

At Fig. u. *Eucyrtidium cranoides*, v. *Acanthastauras purpurascens*, and Fig. w. *Diploconus fascies*

three forms of skeleton are shown, with the accompanying animal throwing out its radiating processes. It must not be forgotten that all these figures are highly magnified, and that the originals are of microscopic dimensions.

The *Radiolaria* are marine animals, and their remains cover vast spaces of the bed of the ocean, frequently at an immense depth.

Order II. Foraminifera.

These must generally be distinguished by their skeleton being formed of carbonate of lime; though some forms are without a skeleton. Here, too, the shells exhibit openings, through which the protoplasm of the animal protrudes.

Fig. x. *Polystomella strigilata* is a living species, with a skeleton divided into chambers, and riddled with holes through which the protoplasmic threads project.

Fig. y. *Bulimina pupoides* fig. z. *Globigerina conglomerata* and fig. z a. *Biloculina ringens* are three more highly magnified skeletons of *Foraminifera*, which form the chief constituent of common chalk. Thus these microscopic creatures play at least as great a part in the formation of the world as the coral animal themselves. And they still swim by myriads at a moderate depth in the sea, and their shells sink to the bottom in heaps in the "Glo-

gerina Zone" of the Atlantic, to form the chalk deposits of future ages.

Fig. z b. *Amœba princeps* has no skeleton and no fixed form, but is always changing its shape. These simple cells are formed in damp mud, and stand not only at the very lowest point in the animal kingdom, but at the actual limit between the animal and vegetable kingdoms, which are no longer separable in their lowest forms, so far as our present knowledge extends. Many low animals and plants, as well as many cells in the higher animals, exhibit the same characters as the *Amœba*, in their earliest stage. Thus it is not only the first link in the long chain of animal organisms, but is also the foundation-stone on which the whole of organic nature is reared; itself so varied in its innumerable forms, and yet possessing an indivisible unity.





b) Horrid Rattlesnake.
Crotalus horridus.

a) Boa Constrictor.



a) Cobra-di-Capello.
Naja tripudians.

b) Viper.
Pelias berus.

c) Common Snake.
Tropidonotus natrix.

d) Serpent of Æsculapius.
Coluber Æsculapii.



a) *Coluber austriacus*.

b) *Coluber flavescens*.

c) Black-backed Sea-Snake.
Pelamis bicolor.

d) Blind Worm.
Anguis fragilis.



a) Mississippi Alligator.
Alligator lucius.

b) Common Crocodile.
Crocodilus vulgaris.



a) Chamaeleon.
Chamaeleo vulgaris.

b) Sand Lizard.
Lacerta agilis.

c) Wall Lizard.
Lacerta muralis.

d) Iguana.
Iguana tuberculata.

e) Basilisk.
Basiliscus vulgaris.

f) Flying Dragon.
Draco volans



Salvadora maculata

Desmognathus fusca

Desmognathus fusca

Desmognathus fusca



a) Common Toad.
Bufo vulgaris.

b) Natterjack Toad.
Bufo calamita.

c) Surinam Toad.
Pipa americana.

d) Edible Frog.
Rana esculenta.

e) Green Tree-Frog.
Hyla arborea.



a) Green Turtle.
Chelonia mydas.

b) Land Tortoise.
Testudo graeca.

c) Hawk's-bill Turtle.
Caretta imbricata.

d) River Tortoise.
Emys europaea.





a) Shark.
Carcharias vulgaris

b) Hammer-headed Shark
Zygena malleus.

c) Sawfish.
Pristis antiquorum



a) Eagle Ray.
Myliobatis aquila.

b) Torpedo.
Torpedo marmorata.

c) Thornback Skate.
Raia clavata.

d) Lamprey.
Petromyzon marinus.

e) Lampern.
Petromyzon fluviatilis.

f) Small Lampern.
Petromyzon Planeri.

g) Mud Lamprey.
Petromyzon Planeri (immature).



a) Lump Fish.
Cyclopterus lumpus.

b) Fishing Frog.
Lophius piscatorius.

c) Sturgeon.
Acipenser sturio.

d) *Acipenser huso*.

e) Sterlet.
Acipenser ruthenus.

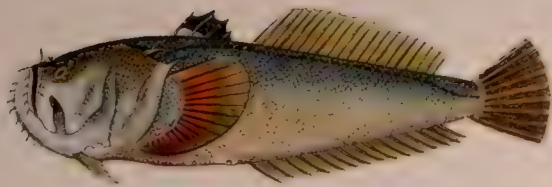
f) Horned Trunk-fish.
Ostracion cornutus.

g) Sea Hedgehog.
Diodon hystrix.

h) *Tetradon stellatus*.



a) Sunfish. *Orthogoriscus mola.*
 b) Great Pipe-fish. *Syngnathus acus.*
 c) Sea Horse. *Hippocampus antiquorum.*
 d) Sea Dragon. *Pegasus draco.*
 e) Electric Eel. *Gymnotus electricus.*
 f) Eel. *Anguilla fluvialis.*
 g) Muræna Helena. *Anarrhichas lupus.*
 h) Wolf-fish. *Anarrhichas lupus.*
 i) Sword-fish. *Xiphias gladius.*



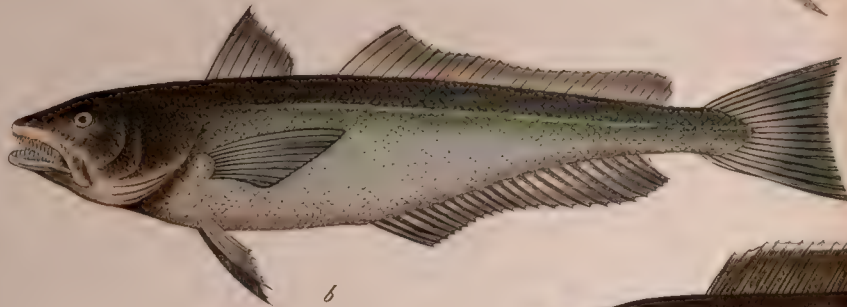
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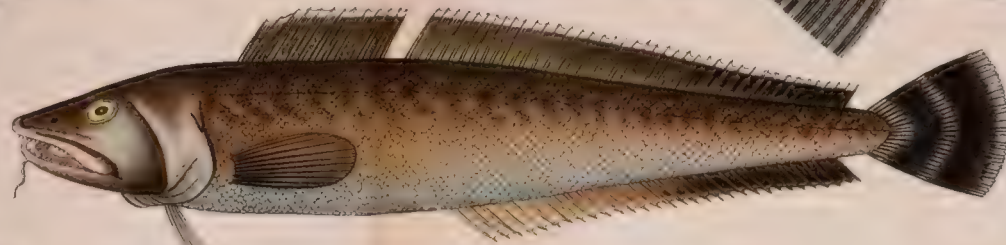
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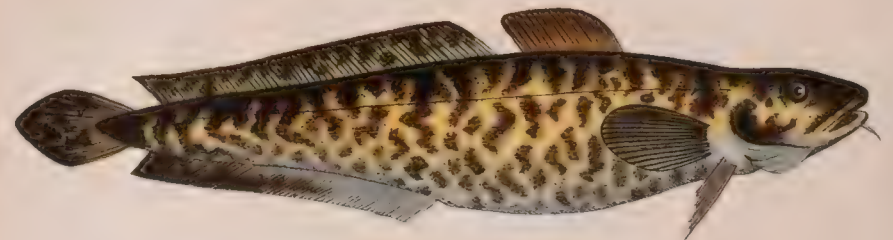
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h

a) Star-gazer.
Uranoscopus scaber.

b) Hake.
Merluccius vulgaris.

c) Ling.
Molva vulgaris.

d) Cod.
Gadus morhua.

e) Haddock.
Gadus aeglefinus.

f) Dorse.
Gadus callarias.

g) *Gadus minutus.*

h) Eel Pout.
Lota vulgaris.



a) Blenny.
Blennius viviparus.

b) Bull-head.
Cottus gobio.

c) Sucking Fish.
Echineis naucrates.

d) Red Scorpion Fish.
Scorpena scorpio.

e) Mackarel.
Scomber scomber.

f) Tunny.
Thynnus thynnus.

g) Stickleback.
Gasterosteus aculeatus.

h) Climbing Perch.
Anabas scandens.

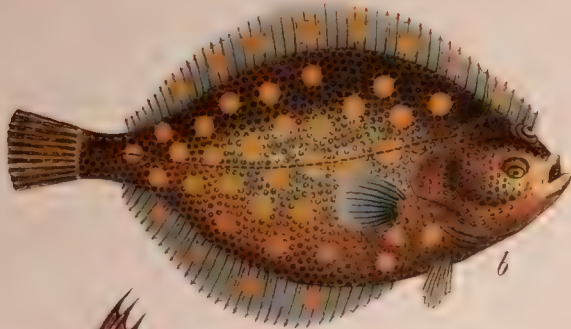
i) Black Goby.
Gobius niger.

j) Grey Gurnard.
Tripla Gurnardus.

k) Flying Gurnard.
Dactylopterus volitans.



d



b



c



e



h



f



g



i



j

a) John Dory.
*Zeus faber.*b) Plaice.
*Pleuronectes platessa.*c) Holibut.
*Hippoglossus vulgaris.*d) Perch.
*Perca fluviatilis*e) Pike Perch.
*Lucioperca Sandra*f) Ruffe.
*Acerina cernua.*g) Red Mullet.
*Mullus barbatus.*h) Wrasse
*Julis mediterranea.*i) Grey Mullet
Mugil cephalus



a) Loach.

Nemachilus barbatulus.

b) *Nemachilus fossilis.*

c) *Cobitis taenia*

d) *Silurus glanis.*

e) Flying Fish.
Exocoetus volitans.

f) Herring.
Clupea harengus.

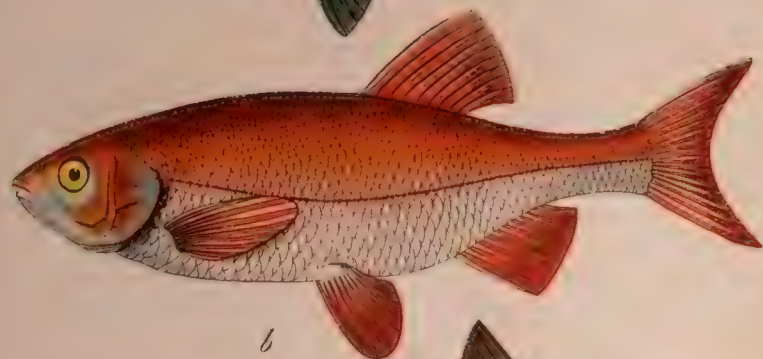
g) Anchovy.
Engraulis encrasicolus.

h) Carp.
Cyprinus carpio.

i) Tench.
Tinca vulgaris.



a



b



c



d



e



f



g



h

a) Bream.
Abramis brama.

b) *Leuciscus orfus.*

c) Crucian Carp.
Carassius carassius.

d) Rudd.
Leuciscus erythrophthalmus.

e) Roach.
Leuciscus rutilus.

f) Chub.
Leuciscus cephalus.

g) *Leuciscus idus.*

h) Dace.
Leuciscus vulgaris.





a) Bleak.
Leuciscus alburnus.

b) *Chondrostoma nasus.*

c) Minnow.
Leuciscus phoxinus.

d) *Abramis vimba.*

e) *Rhodeus amarus.*

f) Gudgeon.
Gobio vulgaris.

g) Barbel.
Barbus vulgaris.

h) *Abramis blicca.*

i) Gold Fish.
Carassius auratus.

k) Salmon.

l) Trout.



a



b



c



d



e



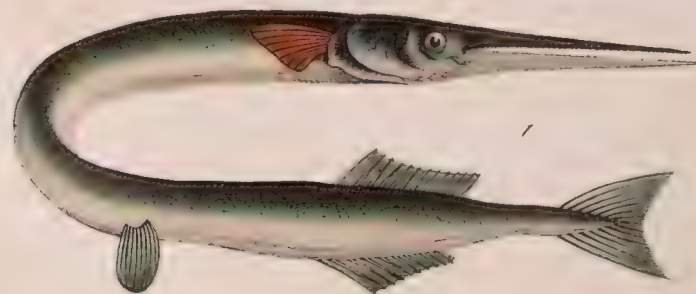
f



g



h



i

a) Salmon Trout.
Salmo trutta.

b) *Salmo hucho.*

c) Lake Trout.
Salmo lacustris.

d) *Salmo salvelinus.*

e) Grayling.
Thymallus vulgaris.

f) *Coregonus Wartmanni.*

g) Smelt.
Osmerus eperlanus.

h) Pike.
Esox lucius.

i) Garfish.



a, b) Pearly Nautilus.
Nautilus pompilius.

c) Common Cuttlefish.
Sepia officinalis

d) Common Octopus.
Octopus vulgaris

e) Paper Nautilus.
Argonauta argo.

l, *Chlo borealis*. g) *Eolsia coarctatus*. i.) Sea Hare (*Aplysia depilans*). j) Limpet (*Patella granatina*). k) *Chiton squamosus*. l) Ear Shell (*Haliotis iris*). m) *Lochus marginatus*. n) *Lurdo pethidatus*. o, *Nerita exima*. p) Winkle Trap (*Scholaria pectinosa*). q) *Nalarius communis*. r) *Voluta ethiopia*. s) Harp Shell (*Harpa ventricosa*). t) Mitre Shell (*Mitra episcopalis*).



a) Rock Shell (*Murex trunculus*). b) Cone (*Conus auratus*). c) Turb Cowry (*Cypraea turris*). d) Money Cowry (*Cypraea moneta*). e) Triton noddy (*Triton noddy*). f) Cassis tuberosa. g) Dolium galea. h) Strombus auris Dianae. i) Strombus pugilis. k) Water Snail (*Limnaea stagnalis*). l) Planorbis cornutus. m) Planorbis carinatus. n) (*Scarabaeus* *auratus*). o) Red Slug (*Arion rufus*). p) Garden Slug (*Limax hortensis*). q) Pupa uva. r) Bulimus *de* Blatus. s) Edible Snail (*Helix pomatia*). t) *Helix nemoralis*. u) *Atlanta Peronii*.

a) Clam (*Tridacna gigas*). b) Scallop (*Pecten maximus*). c) *Spondylus gadaropus*. d) Oyster (*Ostrea edulis*). e) Pearl Mussel (*Meleagrina margaritifera*). f) *Perna nobilis*. g) Noah's Ark Shell (*Arca Noe*). h) Mussel (*Mytilus edulis*). i) *Anodonta anatina*. k) *Unio pictorum*.



a) Hammer Shell (*Malleus vulgaris*). b) Cockle (*Cardium Costatum*). c) *Cyclas cornea*. d) *Tellina virgata*. e) *Venus verrucosa*. f) Razor-Shell (*Solen vagina*). g) Piddock (*Pholas dactylus*). h) Ship-worm (*Teredo navalis*). i) *Dentalium entale*. k) *Terebratula vitrea*. l) *Lingula anatina*. m) *Eschara cervicornis*. n) *Salpa zonaria*. o) *Cynthia ramus*. p) *Pyrosoma atlanticum*.

(Microscopic objects, highly magnified.) q) *Epistylis flavicans*. r) *Vorticella marina*. s) *Stylonichia mytilus*. t) *Noctiluca miliaris*. u) *Eucyrtidium cranoides*. v) *Acanthastauris purpurascens*. w) *Diploconus fascies*. x) *Polystomella strigillata*. y) *Bulimina pupoides*. z) *Globigerina conglomerata*. z a) *Biloculina ringens*. z b) *Amoeba princeps*.



a) Goat (magnified) (*Culex pipiens*). b) Crane Fly (*Pachyrhina pratensis*). c) Gad Fly (*Sabaneus bavinus*). d) Hematopa pluvialis. e) Bombylius major. f) Volucella bombylans. g) Hot Fly (*Hydropodermis bovis*). h) Sarcophaga carnaria. i) Bluebottle (*Musca vomitoria*). j) Housefly (and head magnified, (*Musca domestica*)). k) Stomoxys calcitrans. l) Phora incrassata. m) Flea (*Pulex irritans*). n) Chigoe (*Sarcophylla penetrans*). o) Lepas anatifera. p) Balanus tintinnabulum. r) 1 & 2 Coronula balaenaris. s) Sacculina carcini

a) Scolopendra morsitans. b) Lithobius forficatus. c) Glomeris limbata. d) Scorpion (*Androctonus occitanicus*). e) Book Scorpion (*Chelifer cancroides*). f) Tarantula (*Lycosa Tarantula*). g) Linyphia montana. h) House Spider (*Tegenaria domestica*). i) Garden Spider (*Epheira diadema*). k) Water Mite (*Hydrachna geographica*). l) Beetle Mite (*Gamasus Colocolatorum*). m) Cheese Mite (*Tyroglyphus siro*). n) Dog Tick (*Ixodes ricinus*).



a) Rhinoceros Beetle (*Oryctes nasicornis*). b) Dung-Beetle (*Geotrupes stercorarius*). c) *Copris lunaris*. d) Sacred Beetle (*Scarabaeus sacer*). e) *Aphodius fimetarius*. f) Cockchafer (*Melolontha vulgaris*). g) *Melolontha fullo*. h) Rose Chafer (*Cetonia aurata*). i) Stag Beetle (*Lucanus cervus*). j) *Bostrychus typographus*. k) Burying Beetle (*Necrophorus vespillo*). l) Gold Beetle (*Carabus auratus*). m) *Calosoma inquisitor*. n) Green Tiger-Beetle (*Cicindela campestris*). o) Mealworm Beetle (*Tenebrio molitor*). p) Great Water Beetle (*Hydrophilus piceus*). q) Click Beetle (*Elatea nigræ*). r) *Molytes coronatus*. s) Death Watch (*Anobium pertinax*). t) *Lamproyris splendidula*. u) Blister Beetle (*Cantharis vesicatoria*). v) Oil Beetle (*Meloe proscarabaeus*). w) *Acanthosinus adilis*. x) *Prionus coriarius*. y. *Crioceris meridionalis*. z) Seven-spot Lady-Bird (*Coccinella septempunctata*).



a) Earwig (*Forficula auricularia*). b) Cockroach (*Blatta orientalis*). c) Praying Mantis (*Mantis religiosa*). d) Great Green Grasshopper (*Phasgonura viridissima*). e) Mole Cricket (*Gryllotalpa vulgaris*). f) House Cricket (*Gryllus domesticus*). g) Field Cricket (*Gryllus campestris*). h) Migratory Locust (*Locusta migratoria*). i) *Eidopoda stolidum*. j) Dragonfly (*Calopteryx virgo*). k) Mayfly (*Ephemera vulgata*). l) Caddis Fly (*Phryganea grandis*). m) Lace-winged Fly (*Chrysopa perla*). n) Ant Lion (*Myrmelcon formicarius*). o) Scorpion Fly (*Panorpa communis*). p) *Raphidia ophiopsis*. q) White Ant (male). (*Termes angustatus*). r) White Ant (female) (*Termes angustatus*).



1. *Phaenocarpa* 2. *Phaenocarpa* 3. *Phaenocarpa* 4. *Phaenocarpa* 5. *Phaenocarpa* 6. *Phaenocarpa* 7. *Phaenocarpa* 8. *Phaenocarpa* 9. *Phaenocarpa* 10. *Phaenocarpa* 11. *Phaenocarpa* 12. *Phaenocarpa* 13. *Phaenocarpa* 14. *Phaenocarpa* 15. *Phaenocarpa* 16. *Phaenocarpa* 17. *Phaenocarpa* 18. *Phaenocarpa* 19. *Phaenocarpa* 20. *Phaenocarpa* 21. *Phaenocarpa* 22. *Phaenocarpa* 23. *Phaenocarpa* 24. *Phaenocarpa* 25. *Phaenocarpa*



a) Large White (*Pieris brassicae*). b) Pale Clouded Yellow (*Colias hyale*). c) Brimstone Butterfly (*Gonepteryx rhamni*).
 d) Small Skipper (*Thymelicus thymas*). e) *Erynnis alcea*. f) Eyed Hawk-moth (*Smerinthus ocellatus*). g) Poplar Hawk-moth (*Smerinthus populi*). h) Oleander Hawk-moth (*Daphnis nerii*). i) Elephant Hawk-moth (*Charocampa elpenor*).
 k) Spurge Hawk-moth (*Delilephila euphorbiae*). l) Privet Hawk-moth (*Sphinx liguster*). m) Unicorn Hawk-moth (*Sphinx consocii*). n) Death's Head Hawk-moth (*Acherontia atropos*). o) Humming Bird Hawk-moth (*Macroglossa stellatarum*).
 p) *Egeria apiformis*. q) *Trochilium formicaforme*. r) Six-spot Burnet (*Anthrocera filipendula*). s) *Anthrocera carniolica*.

a) Ghost Moth (*Hepialus humuli*). b) Wood Leopard Moth (*Zeuzera auctus*). c) Great Peacock Moth (*Saturnia pyri*).
 d) Tau Emperor (*Aglaia tau*). e) Lappet Moth (*Gastropacha quercifolia*). f) Lackey Moth (*Clisiocampa neustria*). g) Processionary Moth (*Cnethocampa processionae*). h) Bull Tip (*Phalera bucephala*). i) Gipsy Moth (*Oncetria dispar*). k) Tiger Moth (*Arctia caja*). l) Jersey Tiger Moth (*Callimorpha hera*). m) *Panolis piniperda*. n) Cabbage Moth (*Plutella brassicae*).
 o) *Manestra pini*. p) Gamma Moth (*Plusia gamma*). q) Cluden Nonpareil (*Calocala fraxini*). r) Red Underwing (*Calocala nupta*). s) Common Yellow Underwing (*Triphana pronuba*). t) Scarce Green Silver-lines (*Hylophila bicolorana*). u) Lilac Moth (*Pericallia syringaria*). v) *Hibernia defoliaria*. w) Magpie Moth (*Abraxas grossulariata*). x) Winter Moth (*Chelonia brumata*). y) Clothes Moth (*Tinea sarcitella*). z) Clothes Moth (*Tinea pellionella*). aa) Corn Moth (*Tinea granella*).



a) *Colossendeis gigantea*. b) King Crab (*Lithinus kingi*). c) Crayfish (*Decapoda*). d) Lobster (*Homarus*). e) Spiny Lobster (*Palaeomonetes*). f) Hermit Crab (*Pagurus*). g) Land Crab (*Geocaracus*). h) Mitten Crab (*Cancer*). i) Spider Crab (*Mitho*). j) Scud. k) Amphipod. l) Water Flea (*Daphnia*). m) Water Flea (*Daphnia*). n) Water Flea (*Daphnia*). o) Fresh-water Shrimp (*Gammarus*). p) Wood-louse (*Oniscus*). q) Porcellio. r) Crustacean. s) Brine Shrimp (*Artemia*). t) Apus. u) Apus. v) Water Flea (*Daphnia*). w) Carp Louse (*Argulus*). x) Cypris. y) Larva.

n) *Caprellia spinicarpa*. o) Whale Louse (*Cymus celi*). p) Fresh-water Shrimp (*Gammarus pulex*). q) Wood-louse (*Oniscus*). r) Porcellio. s) Brine Shrimp (*Artemia salina*). t) Apus. u) Apus. v) Water Flea (*Daphnia*). w) Carp Louse (*Argulus*). x) Cypris. y) Larva.



a) Wheel Animalcula (*Rotifer vulgaris*), highly magnified. b) Sea Mouse (*Aphrodite*). c) *Polynoe impatiens*. d) *Nereis margaritacea*. e) *Eone lucida*. f) *Siphostoma diplochelus*. g) Lug-worm (*Arenicola puer*). h) *Serpula contortuplicata*. i) Earth-worm (*Lumbricus terrestris*). k) Nautilus (*Nautilus*). l) Leech (*Hirudo medicinalis*). m) Horse-Leech (*Aulacostomum gulo*).

n) *Bonellia viridis*. o) *Sipunculus Bernhardus*. p) *Trichina spiralis*. q) Guinea Worm (*Dracunculus medinensis*). r) *Ascaris lumbricoides*. s) *Echinorhynchus gigas*. t) *Planaria alba*. u) Liver Fluke (*Fasciola hepatica*). v) *Parascaris equorum*. w) Tape-worm, a head, b joints (*Almonia*). x) Tape-worm, a head, b joints (*Tenia saginata*). y) *Levinseni* (immature form). z) *Cenurus cerebralis*. zz) *Bothriocephalus latus* (a head, b joints).



a) Sea Urchin (*Echinus sphaera*). b) *Astrocladia mamillata*. c, *Squilla nexapora*. d) Starfish (*Asterias aurantiaca*).
e) *Ophiura laceriosa*. f) *Gorgonocephalus arboraceus*. g) *Pentacrinus caput Medusae*. h) Sea-Cucumber (*Holothuria tubulosa*).

i) *Nereis lucifuga*. j) *Berz ovata*. k) *Cestum veneris*. l) *Cydiopsis pileus*. m) *Medusa aurita*. n) *Pelagia panopyra*.
o) *Cephea papuensis*. p) *Rhizostoma aldrovandi*. q) *Velella scaphidia*. r) *Diphyes gracilis*. s) Portuguese Man-of-War
(*Physalia physalis*).



a) *Phryganopora nuxia*. b) *Corymorpha nutans*. c) *Bourgainvillia ramosa*. d) Fresh-water Hydra (*Hydra viridis*).
 e) Dead Man's Fingers (*Alcyonium palmatum*). f) Sea-Pen (*Pennatulula phosphorea*). g) *Umbrellula euerinus*. h) *Renilla*
violacea. i) Venus' Fan (*Gorgonia flabellum*). k) Red Coral (*Coralis nuxia*). l) *Tubipora purpurea*. m) *Sagartia rosea*

n) *Opelet* (*Anthea cereus*). o) Beadlet (*Actinia mesembryanthemum*). p) *Madrepora verrucosa*. q) *Fungia scutaria*. s) *Axi-*
nella polypoides. t) Venus' Flower Basket (*Euplectella aspergilum*).

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